# ENVIRONMENTAL ASSESSMENT

# CALIFORNIA SPACEPORT

# VANDENBERG AIR FORCE BASE, CALIFORNIA

U.S. Air Force (30SW/ET)
Vandenberg Air Force Base CA 93437

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## LIST OF ABBREVIATIONS

| Acronym | Description |
|---|---|
| ACS | Attitude Control System |
| AFB | Air Force Base |
| AFR | Air Force Regulation |
| AFSPC | Air Force Space Command |
| AGE | Aerospace Ground Equipment |
| $Al_2O_3$ | Aluminum Oxide |
| APE | Area of Potential Effect |
| APCD | Air Pollution Control District |
| ARB | California Air Resources Board |
| ASRM | Advanced Solid Rocket Motor |
| BPA | Booster Processing Area |
| CAA | Clean Air Act |
| CCC | California Coastal Commission |
| CCSI | California Commercial Spaceport, Inc. |
| CEQ | Council on Environmental Quality |
| CERL | Construction Engineering Research Laboratory |
| CFCs | Chlorofluorocarbons |
| CFR | Code of Federal Regulations |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| CSEL | C-Weighted Decibel or Sound Exposure Level |
| CWA | Clean Water Act |
| DOD | Department of Defense |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| ELV | Expendable Launch Vehicle |
| EPA | Environmental Protection Agency |
| EPRI | Electric Power Research Institute |
| ERF | Environmental Research Foundation |
| ES | Equipment Section |
| ESBM | Equipment Section Boost Motor |
| FIP | Federal Implementation Plan |
| FONSI | Finding of No Significant Impact |
| GHe | High Pressure Helium |
| $GN_2$ | Gaseous Nitrogen |
| $H_2$ | Hydrogen |
| $H_2O$ | Water |
| HC | Hydrocarbon |
| HCl | Hydrogen Chloride |
| HFCs | Hydrofluorocarbons |
| HSF | Hypergolic Storage Facility |
| HTPB | Hydroxyl Terminated Polybutadiene |
| IPA | Isopropyl Alcohol |
| IPF | Integrated Processing Facility |
| IRIG | Inter Range Instrumentation Group |
| ITL | Integrated-Test-Launch |
| LCC | Launch Control Center |
| LEO | Low Earth Orbit |
| LLV | Lockheed Launch Vehicle |
| $LO_2$ | Liquid Oxygen |
| Lockheed | Lockheed Missiles & Space Company |

| Acronym | Description |
| --- | --- |
| MLP | Mobile Launch Platform |
| MOL | Manned Orbital Laboratory |
| msl | mean sea level |
| MST | Mobile Service Tower |
| $N_2$ | Nitrogen |
| $N_2H_4$ | Hydrazine |
| $N_2O_4$ | Nitrogen Tetroxide |
| NAAQ | National Ambient Air Quality |
| NAGPRA | Native American Graves Protection and Repatriation Act of 1990 |
| NEPA | National Environmental Policy Act |
| $NH_3$ | Ammonia |
| NHPA | National Historic Preservation Act |
| NMFS | National Marine Fisheries Service |
| NO | Nitric Oxide |
| $NO_2$ | Nitrogen Dioxide |
| $NO_x$ | Oxides of Nitrogen |
| NPS | National Park Service |
| NRHP | National Register of Historic Places |
| $O_2$ | Oxygen |
| $O_3$ | Ozone |
| ODP | Ozone Depleting Potential |
| OSB | Operations Support Building |
| Pb | Lead |
| PCB | Polychlorinated Biphenyl |
| PEA | Payload Encapsulation Area |
| PEL | Permissible Exposure Limit |
| $PM_{10}$ | Particles Less Than 10 Microns in Diameter |
| PPR | Payload Preparation Room |
| PSD | Prevention of Significant Deterioration |
| R&IA | Receiving & Inspection Area |
| REEDM | Rocket Exhaust Effluent Diffusion Model |
| REL | Recommended Exposure Limit |
| RWQCB | Regional Water Quality Control Board |
| SAB | Shuttle Assembly Building |
| SCCAB | South Central Coast Air Basin |
| SCF | Stack and Checkout Facility |
| sd | standard deviation |
| SHPO | State Historic Preservation Officer |
| SIP | State Implementation Plan |
| SLAMS | State and Local Air Monitoring System |
| SLC | Space Launch Complex |
| SLF | Spaceport Launch Facility |
| $SO_2$ | Sulfur dioxide |
| SPEGL | Short-term Public Emergency Guidelines |
| SRB | Solid Rocket Booster |
| SW | Space Wing |
| t | time |
| TCLC | Titan IV/Centaur Launch Complex |
| TLV | Threshold Limit Value |
| TCC | Test Control Center |
| USAF | United States Air Force |
| USFWS | United States Fish and Wildlife Service |
| VAFB | Vandenberg Air Force Base |

| Acronym | Description |
| --- | --- |
| VOC | Volatile Organic Carbon |
| WCSC | Western Commercial Space Center, Inc. |
| WR | Western Range |

## UNITS OF MEASURE

| Acronym | Description |
|---|---|
| $^oC$ | degrees Celsius |
| cfs | cubic feet per second |
| cm | centimeter |
| dB | Decibel |
| dBA | A-Weighted Decibel or Sound Exposure Level |
| dBB | B-Weighted Decibel or Sound Exposure Level |
| dBC | C-Weighted Decibel or Sound Exposure Level |
| $^oF$ | degrees Fahrenheit |
| ft | foot |
| ha | hectare |
| Hz | Hertz or Cycles per Second |
| in | inch |
| $^oK$ | degrees Kelvin |
| kg | kilogram |
| km | kilometer |
| knot | nautical mile per hour |
| l | liter |
| lb | pound |
| m | meter |
| meq | milliequivalent |
| mg | milligram |
| mho | inverse ohm (conductance) |
| mi | mile |
| mph | miles per hour |
| mw | milliwatt |
| nm | nautical mile |
| ppm | Parts per million |
| ppt | Parts per thousand |
| psf | Pounds per square foot |
| psi | Pounds per square inch |
| sec | second |
| yd | yard |
| yr | year |

## EXECUTIVE SUMMARY

This environmental assessment (EA) for the California Spaceport, Vandenberg Air Force Base, California, has been prepared in accordance with Air Force Regulation 19-2, Environmental Impact Analysis and the National Environmental Policy Act (NEPA). The major federal actions triggering NEPA in this project are (1) the USAF's proposed lease to WCSC of the Payload Preparation Room at SLC-6 for use as an Integrated Processing Facility and land adjacent to SLC-6 for development of the Spaceport Launch Facility and (2) the possible grant by the DOT of a license to operate a commercial spaceport. The purpose of this EA is to examine the potential for significant environmental impacts resulting from the construction, operation and maintenance of the California Spaceport. The proposed project is to construct and operate facilities to perform commercial space launches of payloads into polar, low earth orbits from South Vandenberg AFB. This would require the adaptation of existing facilities for their new missions and the development and construction of new facilities.

The California Spaceport is needed to provide commercially-owned and -operated space launch facilities for small- to medium-sized launch vehicles and payloads. In order to compete successfully in the growing commercial space market, cost-effective and efficient facilities are required. The Spaceport would contribute to a strong and viable US commercial space program which is able to successfully compete in the international market place.

The Spaceport would be administered by Western Commercial Space Center, Inc. (WCSC) and California Commercial Spaceport, Inc. (CCSI). While the Spaceport would operate as a commercially leased facility, all activities would be conducted within the regulations and procedures of Vandenberg AFB. The transaction is to lease land that is not presently needed for Air Force use (see 10 USC Section 2667) and "excess" launch property to WCSC for development of the Spaceport. The facilities would then be licensed by DOT to operate as a commercial Spaceport.

The location of the proposed action is on South Vandenberg AFB. Preparations of rocket components and payloads would be performed at the Integrated Processing Facility (IPF). The IPF is the former Payload Preparation Room (PPR) at SLC-6. A launch control center and other administrative offices would also be located at the IPF. Final assembly and launch of the rockets and their payloads would be performed at the Spaceport Launch Facility (SLF). Support functions and communications facilities would be provided at the Operations Support Building (OSB) which would be located adjacent to the launch pad.

CCSI proposes to eventually launch up to 24 payloads per year into polar orbit after a phased construction program, which would continue for approximately four years. Some rocket boosters may be used to launch payloads with multiple components. An initial launch capability would be achieved in 1996 and increase to a sustained rate of 24 launches per year by 1999-2000. Eight types or families of launch vehicles would be serviced by the Spaceport. Although one potential launch vehicle would have liquid-fueled rocket motors, most of the rocket motors would be solid fueled. None of these launch vehicles would require the use of sound suppression deluge water.

An alternatives analysis was performed to identify the best location for the Spaceport Launch Facility. North Vandenberg AFB locations are not economically or operationally feasible for the construction of the Spaceport. In particular, facilities on North Vandenberg AFB require launch over the ocean and then a turn to the south for ascent to a polar or near polar orbit. This uneconomical option would be necessary to avoid launching directly over populated areas on Vandenberg AFB. Commercial space operations would not be competitive if such flight profiles were necessary. Three sites were found to be viable locations on South Vandenberg AFB. The viable sites are: (1) the preferred alternative, located 0.49 miles south of SLC-6, (2) the Cypress Ridge alternative, located on the south slope of Cypress Ridge, and (3) the SLC-5 North alternative, located 1,500 feet north of SLC-5. All three sites were analyzed as possible locations for the Spaceport. Additional alternative sites on South Vandenberg are not available to WCSC. The No-Action Alternative was also considered.

This EA covers modification of existing facilities, construction of new facilities, the preparation and assembly of major components of launch vehicles, preparation for launch, the launch itself, and immediate post-launch activities.

The IPF would be located in the former PPR at Space Launch Complex (SLC-6) on South Vandenberg AFB. This facility would be used for its intended purpose. As such, no impacts are anticipated and there are no alternatives considered for this facility. The preparation and assembly of the launch vehicles would occur inside the IPF. The utility requirements include electricity for lights, use of hoists and elevators, communication access trunks and water for drinking and sanitation. Final assembly and testing, as well as the launch itself, would occur at the SLF.

The existing environment has been described in two EISs which analyzed the Space Shuttle and Titan IV/Centaur programs (USAF 1978, USAF 1989a), as well as in a previous EA for the Lockheed Launch Vehicle (LLV) on South Vandenberg (USAF 1994). South Vandenberg is located in the California Coastal Zone near Point Arguello. The location of the preferred alternative is on a small terrace or plateau, approximately 122 m (400 ft) above the Pacific Ocean, and between the ocean and Santa Ynez Mountains. The terrain is rolling and supports coastal sage scrub and grassland communities. The climate is Mediterranean, which is characterized by warm, dry summers and cool, wet winters. During the summer months, morning fog and inversions are common. The mixing height of the lower atmosphere averages between 900 m (2,950 ft) and 1,350 m (4,430 ft).

The environmental consequences of the Spaceport, for each alternative site, are discussed primarily in terms of construction, the rocket exhaust plume, launch noises, sonic boom effects, and the effects on SLC-6. The potential effects of cold spills and catastrophic events, as well as health and safety issues, are also included. To assist in this evaluation, a “region of influence” has been created that encompasses an area from Point Pedernales to Boathouse Flats in order to assess the impacts contained within the region.

Since extensive environmental analyses have been performed for the Lockheed Launch Vehicle (LLV) and since the LLV is representative of the solid-fueled rocket launching systems which would be serviced by the SLF, this family of launch vehicles has been adopted as the example launch vehicle for this EA. The LLV is based on the Castor 120™, which is typical of solid-fueled launch vehicles which would be serviced and launched from the Spaceport. The LLV 2 is the slowest ascending vehicle and the LLV 3 (with up to six strap on Castor IVAs) is the largest solid fueled vehicle expected to be launched from the SLF. The exhaust constituents from liquid-fueled rockets would primarily consist of $CO_2$ and $H_2O$. These compounds would have negligible impacts on the environment. The noise and sonic boom levels of liquid-fueled rocket launches would be similar to those for solid-fueled rockets. Therefore, the LLV represents the maximum potential environmental impacts from launch activities at the SLF. This ensures that all potential impacts have been addressed.

Of the approximately 5.3 ha (13 ac) occupied by the footprint of the Spaceport, 4.6 ha (11.4 ac) of vegetation would be disturbed during construction of the SLF. Losses of coastal sage scrub vegetation would be mitigated by replacement on a 3:1 basis. Several wildlife species of concern are within the region of influence of the preferred alternative site and would be monitored for launch effects. If impacts such as reduced population levels or reduced habitat usage are shown to be caused by rocket launches from the Spaceport, mitigation would be implemented in consultation with VAFB and USFWS. A set of Monitoring and Mitigation Requirements have been generated and would form the basis of a comprehensive program to minimize potential impacts from construction and operation of the Spaceport. These requirements would be the foundation of an agreement between the proponent, the natural resources staff of Vandenberg AFB, and the US Fish and Wildlife Service (USFWS). Approval by the USFWS is required. All mitigation measures identified in the EA, including those in the detailed monitoring and mitigation plan to be developed and implemented based on the protocols and procedures outlined in Appendix G, would be binding and enforceable obligations of the lessee under the lease of land and facilities from the Air Force to WCSC for development of the Spaceport.

The SLC-6 complex and the Payload Preparation Room (Building 375) have been evaluated and recommended not eligible for inclusion on the National Register of Historic Places (NRHP). If the project is implemented at the preferred alternative site, there is no impact to the historic Anza Trail because it would be outside the viewshed of this resource. Based on background research and fieldwork, no adverse impacts to National Register eligible cultural resources are expected from the proposed Spaceport. Because of the buried nature and proximity of prehistoric sites in the vicinity, monitoring would be conducted during Spaceport construction. Any cultural resources discovered during monitoring would be treated in accordance with 36 CFR 800. Appropriate documentation has been prepared and submitted to the State Historical Preservation Officer (SHPO) for the preferred alternative site. The Cypress Ridge alternative and the SLC-5 North alternative would fall within the viewshed of the Anza Trail. The Cypress Ridge alternative is located within visual range of Pt. Conception. This area is described in Chumash folklore as the passageway, the “Western Gate”, through which souls of the dead depart the world. If the Cypress Ridge alternative is chosen for the Spaceport, additional Section 106 (National Historic Preservation Act) compliance would be required to address the issues of the Anza Trail and the Western Gate. If the SLC-5 North alternative is chosen, additional Section 106 would be required to address the Anza Trail issue.

Formal section 7 consultation pursuant to the Endangered Species Act (ESA) has been completed with the National Marine Fisheries Service (NMFS). Impacts to marine mammals on the Channel Islands from sonic booms would not be anticipated. Impacts to harbor seals at Rocky Point would be limited to those associated with launch noises. Harbor seals are known to flush into the water during launches from Vandenberg AFB. Observations made from a nearby location at Vandenberg AFB during a recent Titan IV launch in August 1993 indicated that nearly all of the harbor seals did vacate the haul out area, but the majority of them returned within 24 hours with no identified adverse effects. Previous studies of harbor seal responses to loud noises did not present any evidence of mortality or reduced reproductive rates. The NMFS recommended the initiation of an incidental harassment permit due to the proximity of the haulout area to the preferred alternative site. The permit application process has begun and will be completed prior to first launch.

Public recreation areas, such as Jalama Beach, would not be affected by construction or operation of the Spaceport. A Federal Consistency Determination was submitted to the California Coastal Commission (CCC). The CCC has found the California Spaceport project (CC-42-94) to be consistent to the maximum extent practicable with the California Coastal Management Plan.

No jurisdictional wetlands are located within the footprint of the preferred alternative site. Therefore, there would be no impacts to wetlands from construction of the Spaceport and Section 404, Clean Water Act permitting would not be required. The nearest major drainage is Cañada Honda Creek, which is 3.7 km (2.3 mi) to the north of SLC-6. Since the exhaust plume and launch noise would be directed toward the south of the launch site, there is little chance of cumulative effects from Spaceport launches to Cañada Honda Creek or any other wetland. However, for approximately ten percent of the time during a year winds blow from the south which means that some portion of an exhaust plume may impinge upon Honda Creek. Water quality and vegetation effects would be monitored at Honda Creek during launches where there is a potential for winds from the south.

Formal Section 7 consultation with the US Fish and Wildlife Service (USFWS) under the Endangered Species Act has been initiated. The Biological Opinion from the USFWS would be obtained prior to execution of the lease.

A set of Mitigation and Monitoring Requirements have been developed to form the basis of a comprehensive program minimizing potential impacts to vegetation and wildlife from construction and operation of the Spaceport.

A conformity analysis, in accordance with the Clean Air Act General Conformity Rule, was conducted for potential criteria pollutant emissions for all sources associated with the project. The cumulative project sources were estimated to be within *de minimis* levels for emissions of criteria pollutants.

The Castor 120™ would produce approximately 620 kg (1,367 lb) of exhaust material per second. The LLV 2 is estimated to require 18.4 seconds to reach 914 m (3,000 ft) altitude. Exhaust from these launches would not significantly impact atmospheric resources. The distance to the maximum depositions of $Al_2O_3$, less than 6850 particles per $m^2$, would be 3.0 km (1.9 mi) to 6.0 km (3.7 mi). These particles would not pose a health risk, as they would be mostly much greater than 10 microns in diameter. Under typical meteorological conditions, the Rocket Exhaust Effluent Diffusion Model (REEDM) indicates that hydrogen chloride (HCl) concentrations of 5 parts per million for one minute are expected to occasionally trigger the current launch hold criteria. This reflects a recent, more restrictive change in the maximum allowable limits for HCl recommended by the Air Force Armstrong Laboratory. Vandenberg AFB has implemented the Armstrong Laboratory recommendations. The unavoidable consequence of this is greater likelihood of launch holds.

The azimuth of exhaust plume from Spaceport launches under typical weather conditions would range from $153^o$ to $186^o$ and the plume width would be less than 2.8 km (1.6 mi). The total duration of this event from launch to a return of ambient conditions would be less than 40 minutes. The localized and transient nature of the exhaust plume and its location over ocean water would not present a significant hazard to population centers, recreation areas, soils, vegetation or wildlife.

With regard to the effects of exhaust plumes, the SLC-5 North alternative site may have the most potential for having a significant impact to the environment. This is due to the close proximity of this site to Cañada Honda Creek.

In summary, in the context of the total space launch program at Vandenberg AFB, the Spaceport would not contribute significantly to the total impact on the human and natural environments at the base. Comprehensive mitigations requirements for the Spaceport project have been established to offset any potential adverse impacts, and reduce net impacts to non-significance. Significant impacts resulting from the addition of environmental effects from Spaceport activities to those of other VAFB programs are not anticipated.

# 1.0 PURPOSE AND NEED FOR PROPOSED ACTION

## 1.1 Purpose, Need and Background of the Action

### 1.1.1 Purpose of Proposed Action

Western Commercial Space Center, Inc. (WCSC), a California non-profit public benefit corporation, intends to provide common user facilities to support two activities: 1) preparation of both payloads and launch vehicles, and 2) launch of space vehicles into polar orbits (CCSI 1994). Launch vehicles and payloads would be sponsored by universities, commercial enterprises, and the United States (US) government.

These preparation and launch facilities would be developed, managed, operated, and maintained by a for-profit system management and integration contractor, California Commercial Spaceport, Inc. (CCSI). The facilities would be collectively known as the California Spaceport, or the "Spaceport. Under the transaction, the Air Force would grant a long-term lease to WCSC under the authority of 10 U.S.C. 2667 of land that is not presently needed for Air Force use and excess launch property at South VAFB for development of the Spaceport. CCSI would then seek a license from the Department of Transportation (DOT) to operate its proposed Spaceport. The purpose of the Environmental Assessment (EA) is to evaluate the proposal that the Air Force grant the lease for the use of facilities and other lands, and the possible grant by the Department of Transportation of a license to operate a commercial Spaceport.

### 1.1.2 Need for the Proposed Action

It is the United States policy to seek and encourage maximum commercial use of space, including commercial activities related to US expendable launch vehicle (ELV) launches. 49 U.S.C. Subtitle IX--Commercial Space Launch Transportation, ch 701, Commercial Space Launch Activities, 49 U.S.C. 70101-70119 (1994), provides for the use of excess government launch property by non-Federal entities.

The use of space for commercial communications and science is increasing in the face of high launch costs. Commercial organizations are expected to provide routine launch services for less cost than available Government services. Commercial organizations can serve numerous potential customers, including some government users, who may not be able to pay for Government furnished launch services. In addition, commercial launch companies are expected to foster competition, which should further reduce costs and increase launch capabilities, while maintaining the same high standards of safety.

Commercial space activities on Vandenberg AFB would help provide jobs and business for the Central Coast region of California. Declining military space missions have caused a significant reduction in the number of highly technical jobs available at Vandenberg. The Spaceport would provide construction jobs in the near-term and space operations jobs beginning in 1996 to help offset these losses.

This project would fulfill, in part, the need for commercial access to polar orbits in space. The proposed project would also provide needed preparation facilities for all sizes of payloads, as well as launch facilities for small- to medium-sized launch vehicles. The Spaceport would be cost effective while simultaneously supporting multiple users by providing booster processing facilities, satellite processing facilities, integration capabilities, a launch control center, and a launch pad capable of supporting multiple booster configurations. In general, the Spaceport would contribute to a strong and viable US commercial space program which is able to successfully compete in the international market place (CCSI 1994).

### 1.1.3 Background of Proposed Action

The Western Commercial Space Center began the process of obtaining user requirements for the construction of a commercial space launch facility in December 1992. A commercially-owned and operated Spaceport would enhance the position of US launch companies in the highly competitive commercial space launch industry. The Spaceport project is the result of a "grassroots" community effort to provide jobs at Vandenberg AFB following the loss of the Space Shuttle program, and to replace jobs lost because of the declining military mission.

As a community-oriented project, WCSC felt obligated to promote early participation from the Air Force, regulatory agencies, the public, and special interests in order to allow changes to the Spaceport planning during the formative stages. After extensive planning with the Air Force, an integrated meeting of all applicable regulators was held in February 1994. This meeting yielded a wealth of useful suggestions on how to approach the regulatory process for the project. One major suggestion was to conduct a public information meeting to receive direct input from the public.

A public information meeting, or "scoping meeting" was conducted in Lompoc, California on 15 March 1994. As a prelude to the public meeting, a detailed briefing on the project was provided to the Native American community on 8 March 1994. Many individual briefings and tours of the proposed project site were provided to individuals, environmental groups, and other interested groups.

Each of these forums provided valuable information that has shaped the implementation of the Spaceport design. The final concept for the Spaceport incorporates the inputs of the participants to the maximum extent possible.

### 1.2 Location of the Proposed Action

The proposed action would be located at Vandenberg Air Force Base (VAFB), Santa Barbara County, California. Vandenberg AFB is administered by the US Air Force and employs 6,870 military, civilian and contractor personnel (USAF 1993b).

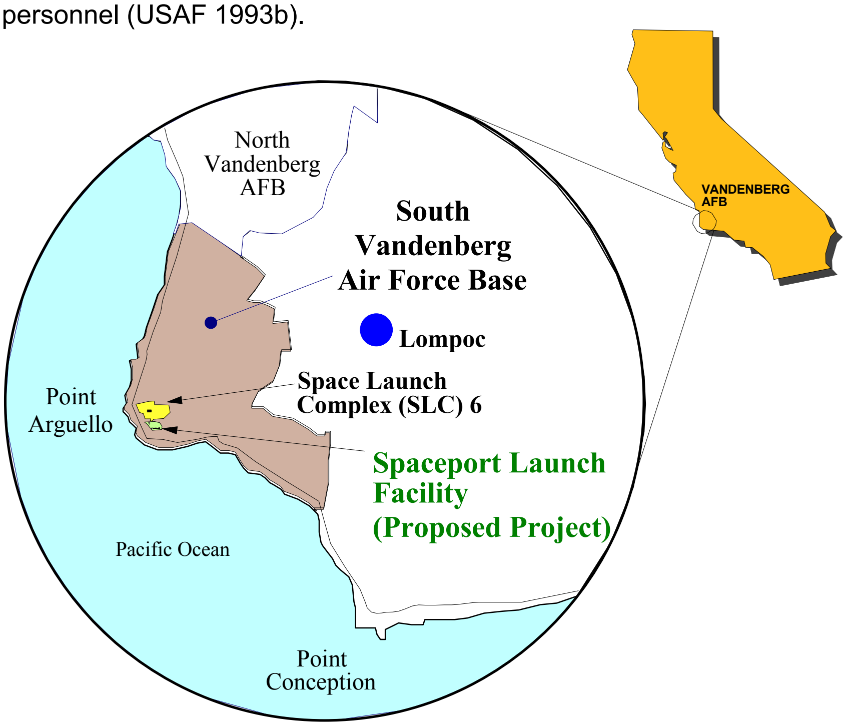


Figure 1.1. Planned Location of Spaceport Launch Facility

A total of 19 types of launch vehicles are currently serviced at VAFB. Currently, South Vandenberg AFB, the proposed location for the Spaceport (Figure 1.1), contains launch facilities for the Atlas, Titan, Scout, and Space Shuttle. Complexes for launch control functions, solid rocket motor storage, payload processing, guidance and communication facilities, radar tracking and surveillance, a road network, a railroad line, and communications networks are also located at South Vandenberg.

Under the proposed action, the Air Force would lease approximately 40.5 ha (100.0 ac) of land and Building 375 on South Vandenberg to WCSC for developing and operating the property as an integrated "Spaceport" system (Figure 1.2). This figure also shows the layout of the Spaceport components in relation to the SLC-6 launch mount, the Solid Rocket Motor Storage facility (Bldg. 330) and the wastewater treatment ponds between the Spaceport and SLC-6.

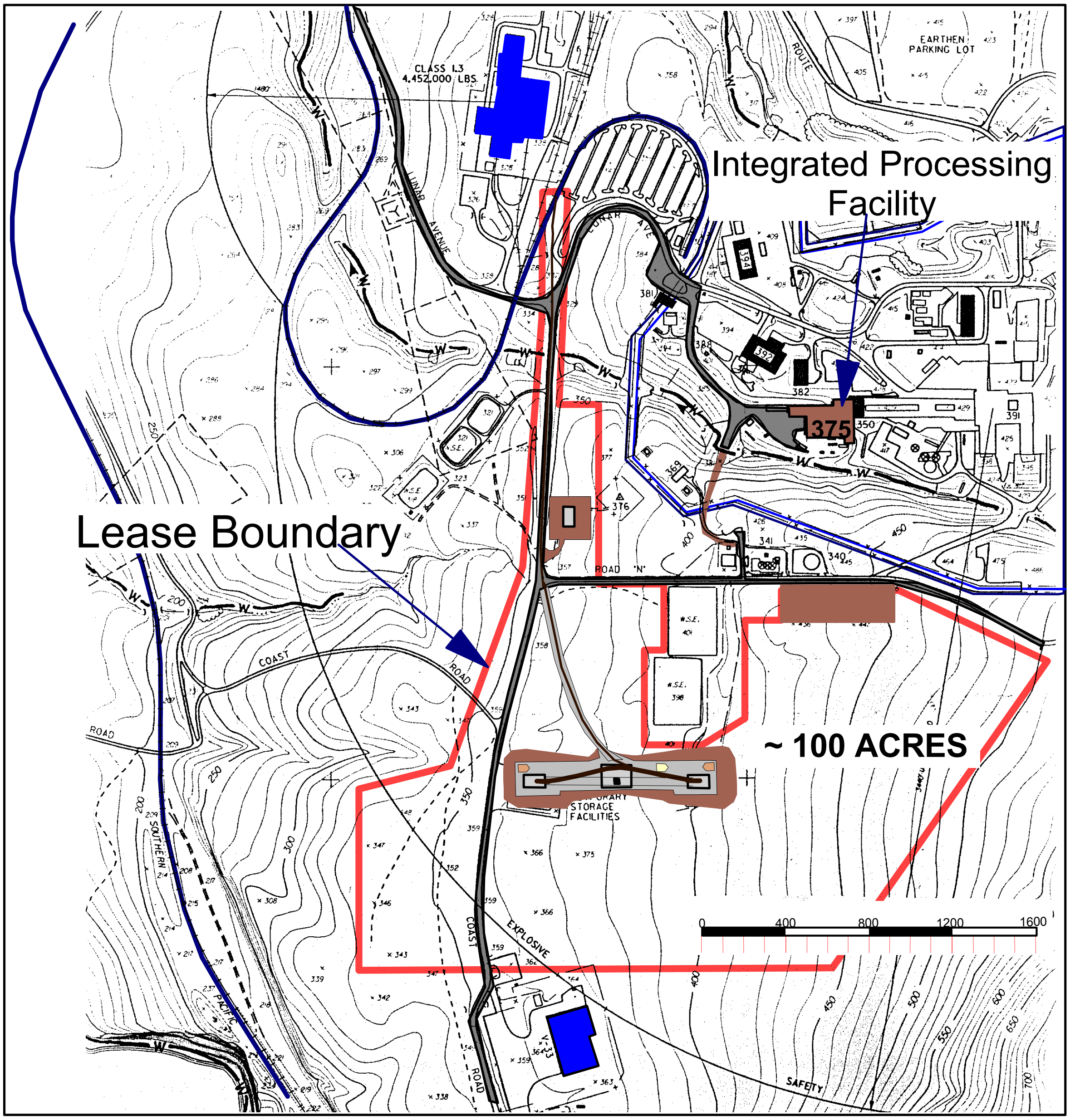


Figure 1.2. Approximate Spaceport Lease Boundary

1) WCSC proposes to develop an IPF at SLC-6 by adapting the existing Payload Preparation Room (PPR), also known as Bldg. 375. The function of the IPF would be to provide customer services support and prepare launch vehicles and payloads. The launch control center for the Spaceport would also be built in rooms available at the IPF. Currently, WCSC has a "right of entry" agreement with the Air Force for the IPF. All mitigation measures identified in the Environmental Assessment, including those in the detailed Monitoring and Mitigation Plan to be developed and implemented based on the protocols and procedures outlined in Appendix G, will be binding and enforceable obligations of the lessee under the lease of land and launch facilities from the Air Force to WCSC for development of the Spaceport.

2) Activities associated with rocket launching, as well as the launch itself, would be conducted at the Spaceport Launch Facility (SLF). This would be built immediately to the south of SLC-6. The SLF would consist of two Stack and Checkout Facilities (SCFs) and a central launch pad. The launch pad would be 0.61 km (0.38 mi) to the southwest of the IPF, and the SCFs would be located approximately 500 feet to the east and the west of the launch pad. An operations support building (OSB) would also be built near the launch pad as an integral part of the SLF.

A long-term lease of the property would be required in order to obtain financing for the Spaceport. The lease would allow construction only on that portion shown in Figure 1.2. The leased property would include an explosive safety "buffer zone" of land that would be maintained by the lessee. The balance of the acreage would remain undeveloped in accordance with the EA. Building facilities within the explosive limits of the Spaceport would severely impact the flexibility of the operations at the Spaceport.

Any required mitigation efforts, such as the vegetation restoration project, or a peregrine falcon hacking program would be contracted for early in the development program to ensure completion in a timely manner, regardless of the status of the Spaceport program.

Range facilities are operated by the Air Force's Western Range. The tracking and communications facilities include sites on Vandenberg AFB and seven other tracking stations around the earth. Launch range instrumentation and tracking equipment must be available from the point of launch until the vehicle flight is terminated, the final stage and payload are inserted into an earth orbit, or the payload departs the earth's system. Vandenberg AFB is an ideal location from which to launch satellites into polar orbit because it has ample tracking and telemetry equipment to support commercial launches. If commercial users were required to duplicate this range infrastructure, they could not provide competitively priced services.

### 1.3 Scope of this Environmental Assessment

The Federal actions are (1) the USAF's proposed lease to WCSC of the Payload Preparation Room at SLC-6 for use as an Integrated Processing Facility and land adjacent to SLC-6 for development of the Spaceport Launch Facility and (2) the possible grant by DOT of a license to operate a commercial spaceport. In addition, the Air Force must approve the operations to be conducted in the PPR and at the SLF. It is the Air Force's policy to provide support services that cannot reasonably be provided through other commercial means.

This environmental assessment (EA) analyzes the impacts to the environment resulting from three planned activities: (1) the modification and operation of the IPF for integration of launch activities and servicing of launch vehicles and payloads, (2) the construction of the SLF, and (3) the on-the-pad launch preparations, launch of space vehicles, and post-launch activities. Potential impacts from operations at the IPF will only be discussed in terms of this one alternative (see Section 2.1.1). Potential impacts from SLF construction and space processing and launch operations will be discussed in terms of three alternatives (see Section 2.2.2.2). As potential impacts for each SLF alternative are discussed, the environmental consequences, as well as monitoring and mitigation, will be introduced, as appropriate.

Issues related to the transportation of motor segments and payloads from the manufacturer to the Spaceport are the responsibility of the individual users. The Spaceport would assist users in obtaining the appropriate transportation permits and coordinating with applicable state and federal transportation regulatory agencies. Transportation of rocket stages and other hazardous materials on base would be in strict accordance with Federal, State, and Air Force regulations and local policies.

### 1.4 Applicable Regulatory Requirements and Agency Coordination

A number of environmental statutes are applicable to the proposed project. Table 1-1 lists the Federal, State, County, DOD and Air Force environmental regulations. A brief description of each of the Federal, State, County, DOD and Air Force environmental statutes is provided in this section.

Table 1-1. Environmental Regulations

**Federal**

National Environmental Policy Act (NEPA)
Council on Environmental Quality (CEQ)
Clean Air Act (CAA)
Coastal Zone Management Act (CZMA)
Clean Water Act (CWA)
Resource Conservation Recovery Act (RCRA)
Toxic Substance Control Act (TSCA)
National Historic Preservation Act (NHPA)
Archeological and Historic Data Preservation Act (AHDPA)
Archaeological Resources Protection Act (ARPA)
American Indian Religious Freedom Act (AIRFA)
Native American Graves Protection and Repatriation Act (NAGPRA)
Endangered Species Act (ESA)
Bald and Golden Eagle Protection Act
Marine Mammals Protection Act (MMPA)
Fish and Wildlife Coordination Act
Migratory Bird Treaty Act
Executive Order 11988, Floodplain Management
Executive Order 11990, Protection of Wetlands
Comprehensive Environmental Response,
Compensation, and Liability Act (Super Fund)
Super Fund Amendment and Reauthorization Act (SARA)
Occupational Safety and Health Administration (OSHA)

**County**

Santa Barbara County Air Pollution Control District (APCD)

**State**

California Clean Air Act (CCAA)
Toxic Air and Contaminants Law
Toxics Hot Spots Information and Assessment Act
California Hazardous Waste Control Law (HWCL)
California Coastal Act
Regional Water Quality Control Board (WQCB)
Resolution 83-12 and Order 83-60
California Porter-Cologne Water Quality Act (WQA)
California Endangered Species Act (CESA)
California Native Plant Protection Act (NPPA)
California Code of Regulations, Title 22,
Division 4, Environmental Health

**DOT**

Commercial Space Launch Act (CSLA)
DOT 5610.1C Procedures for Considering Environmental Impacts

**DOD and Air Force**

DOD 6050.1 (AF Environmental Directive)
AFR 19-2 (AF Environmental Impact Analysis Process)

#### 1.4.1 Federal Regulations

<u>National Environmental Policy Act (NEPA) of 1969</u>
42 USC §§ 4321-4347 (1970-1989)

NEPA requires Federal agencies to analyze the potential environmental impacts of major Federal actions and alternatives and to use these analyses as a decision-making tool on whether and how to proceed with the proposed action. Specifically, NEPA addresses environmental impacts on air, water, soil, biological, and cultural resources. NEPA is a regulatory act in that it has implementing regulation; it defines a process for regulation. NEPA defines the Environmental Impact Statement (EIS) which is required before non-reversible environmental actions are taken. The act was implemented by:

- Executive Order 11514, 42 USC § 4321.

- President's Council on Environmental Quality (CEQ) Regulations, Title 40, Code of Federal Regulations (CFR), Part 1500 *et seq*.

- USAF Regulations 19-1, 19-2, 19-7, and 19-9, containing USAF directives for compliance with NEPA.

Council on Environmental Quality (CEQ)
40 CFR §§ 1500 - 1508

The CEQ regulations establish procedures for accomplishing the Environmental Impact Analysis Process (EIAP). The CEQ establishes the Environmental Assessment (EA). A preliminary Environmental Impact Analysis can result in one of two possible alternatives: Categorical Exclusion (CATEX), or a requirement for an EA. There are three possible outcomes from an EA: No Action (i.e., disapproved), Finding of No Significant Impact (FONSI), or a requirement for an EIS.

Clean Air Act (CAA)
42 USC § 7401 *et seq* (1988)

The CAA requires the US Environmental Protection Agency (EPA) to establish national and secondary ambient air quality standards as necessary to protect public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant. The CAA also requires establishment of: (1) national standards of performance for new stationary sources of atmospheric pollutants; (2) emissions limitations for any new modified buildings; and (3) standards for emissions of hazardous air pollutants. In compliance with these requirements, EPA has issued primary and secondary National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide ($NO_2$), carbon monoxide, particulate matter less than 10 microns diameter, ozone, and lead. Under the Clean Air Act, State and Local authorities were given primary responsibility for assuring that their respective regions attain the NAAQS. This provision also gave state and local agencies authority to enact more stringent ambient air quality. A recent amendment to the CAA is the "Conformity Rule" which became effective January 31, 1994.

The CAA plays an important role in California's air pollution control program. The CAA requires preparation and submission of state implementation plans for attainment of national ambient air quality standards by given target dates. The act also requires the State, acting through the air districts, to enact regulations sufficient to attain and maintain the Federal NAAQS. Hence State of California and County of Santa Barbara authority over air pollution control is Federally granted, and applies to Federal facilities such as Vandenberg AFB.

In order to determine "Conformity" of required Federal actions to State or Federal implementation plans, 40 CFR § 93 requires a determination of conformity of Federal actions to the State Implementation Plan (SIP) for the attainment of National Air Ambient Air Quality Standards (NAAQS). The Air Force is required to make a formal Conformity Analysis as to whether a proposed action complies with the Conformity Rule of the Amended Clean Air Act (CAA) and SBCAPCD Rule 702. The conformity rule requires that total direct and indirect emissions of nonattainment criteria pollutants be considered. The rule does not apply to actions where these emissions would be less than *de minimis* levels, which is defined as 100 tons per year within a moderate nonattainment area.

The CAA was enacted in 1963, amended in 1970 and 1977, and completely overhauled in 1990. CAA Amendments adopted in late 1990 brought about sweeping changes to the Federal CAA. Although these amendments require major changes throughout most of the country, it has limited impact for California, since some of the key provisions were modeled after existing California laws. An operating permit program is required under Title V of the new CAA, and 40 CFR § 70 regulations. The operating permit should contain all applicable emission limitations and operating conditions imposed by the State Implementation Plan (SIP) and Federal air programs.

Coastal Zone Management Act (CZMA)
16 USC § 1451 *et seq* (1972)

The CZMA, as amended, establishes as a national policy the preservation, protection from development, and, where possible, the restoration and enhancement of the nation's coastal zone. To carry out this policy, the Act encourages coastal states to develop Coastal Zone Management Programs. Section 304 of the Act excludes all Federal lands from the coastal zone. However, Section 305 requires Federal agencies that conduct activities, including development projects, which directly affect the state's coastal zone, to make sure that these activities are consistent, to the maximum extent practicable, with approved state Coastal Zone Management Programs.

Clean Water Act (CWA)
33 USC § 1251 *et seq* (1977)

The CWA prohibits the discharge of pollutants from a point source into navigable waters of the US, except in compliance with a National Pollutant Discharge Elimination System (NPDES) (40 CFR Part 122) permit. Through administrative and judicial interpretation, the navigable waters of the US are considered to encompass any body of water whose use, degradation, or destruction would affect interstate or foreign commerce. This definition includes, but is not limited to, inter- and intra-state lakes, rivers, streams, wetlands, playa lakes, prairie potholes, mudflats, intermittent streams, and wet meadows.

Section 401 of the Clean Water Act directs that any action which requires a federal license or permit must also be certified by the state that the action complies with state water quality criteria. The authority to administer this section is delegated in each state to the state water pollution control agency. The permit provided by the state under this section is generally referred to as a 401 Water Quality Certification.

Section 402 requires that the EPA establish regulations for issuing permits for stormwater discharges associated with industrial activity. A NPDES permit is required if activities involve the disturbance of more than five acres of land. The act delegates authority for enforcement to the (California) State Water Resources Board and, ultimately, to the Regional Water Quality Control Board (WQCB). Other regulating agencies include the EPA, DOD-USAF, and the California Environmental Protection Agency (CalEPA).

The Clean Water Act was amended in 1987, adding Section 319, requiring states to assess non-point source water pollution problems and to develop non-point source pollution management programs with controls to improve water quality. Non-point sources involve items such as surface runoff from streets, runoff from agricultural activities, runoff from construction activities, or percolation from such sources into the groundwater. These revisions would require coordinating non-point source planning for proposed project activities with the WQCB.

Under Section 404, dredged or fill materials may not be discharged into waters of the US, including rivers, streams, wetlands, and playa lakes, by or on behalf of any Federal agency, other than the US Army Corps of Engineers (ACOE), without a permit issued pursuant to ACOE rules and regulations. Pursuant to 33 CFR § 320, in issuing such permits, the ACOE must consider the impact that such an activity would have on floodplains and wetlands in accordance with Executive Orders 11988 and 11990.

The Nationwide Permit 26 to Section 404 of the CWA covers discharges of dredged or fill materials that result in a loss of less than ten acres of waters of the US (including wetlands) that are isolated or located in headwaters. Headwaters are defined as the point on a non-tidal stream, above which the average annual flow, or median flow, is less than 5 cfs. The median flow criteria applies to streams with highly irregular flows that could be dry at the headwater point for most of the year, and still average on a yearly basis, a flow of 5 cfs. Manmade non-tidal drainage ditches are by definition not considered to be Waters of the US. Impacts of 1 to 10 acres of waters of the US requires formal pre-discharge notification of the Corps, the Environmental Protection Agency, the Fish and Wildlife Service, the Regional Water Quality Control Board, the California Coastal Commission, and CDFG in the decision making pursuant to authorization of a permit. Impacts totaling less than one acre require 401 certification and California Coastal Commission concurrence prior to assumption of Corps authorization under Nationwide 26.

Resource Conservation and Recovery Act (RCRA)
42 USC § 6901 *et seq* (1976)

The treatment, storage, and disposal of solid waste (both hazardous and non-hazardous) is regulated under the Solid Waste Act, as amended by the RCRA and the Hazardous Solid Waste Amendments of 1984. The RCRA was designed to control the handling and disposal of hazardous substances by responsible parties. Hazardous waste, as defined by the RCRA, is a "solid waste that may cause or significantly contribute to serious illness or death, or that poses a substantial threat to human health or the environment when improperly disposed." In this definition, a solid waste may be "liquid" if it has any of the following properties: "ignitability, corrosivity, reactivity, or toxicity." RCRA provides that States may apply to EPA for authorization to operate their own hazardous waste management programs in lieu of the federal RCRA program. The state program must be substantially equivalent to, and consistent with the federal program, and consistent with other state programs. In 1984, Congress added to RCRA the Hazardous and Solid Waste Amendments (HSWA) of 1984, primarily concerned with placing stringent limitations on land disposal of hazardous wastes and regulation of underground storage tanks.

Toxic Substances Control Act (TSCA)
15 USC § 2601 *et seq* (1976)

TSCA authorizes the EPA to exercise coherent control over toxic substances by obtaining information, including the production, use, and health/environmental effects, of existing and new chemicals, and to take appropriate regulatory action against those substances presenting unreasonable risks. Manufacturers or processors of chemicals may be required to conduct tests and submit to EPA data on the effects and behavior of chemicals. By authority of Section 6 of the Act, the following chemicals are directly regulated by TSCA (40 CFR § 747, §§ 761-766):

- Metalworking fluids (mixed mono and diamides of an organic acid; triethanolamine salt of a substituted organic acid; and triethanolamine salt of tricarboxylic acid).
- Polychlorinated biphenyls (PCBs).
- Fully halogenated chlorofluoroalkanes.
- Asbestos.
- Benzo-para-dioxins/dibenzofurans.

National Historic Preservation Act (NHPA)
16 USC § 470 *et seq* (1966)

The NHPA is the key Federal law designed to encourage identification and preservation of cultural resources. The act establishes the National Register of Historic Places (NRHP) to designate public or privately-owned resources. Properties which are not listed, but are considered eligible, are also protected. The Act requires coordination of Federal preservation efforts with the State Historic

Preservation Officer (SHPO). The Advisory Council on Historic Preservation (ACHP) is established under 16 U.S.C., sec. 470i which sets forth the Section 106 requirement and allows the ACHP an opportunity to comment. Section 106 requires Federal agencies to take into account the effect of undertakings on properties included in, or eligible for, the NRHP. The Section 106 process involves the Federal agency, the SHPO, and often the ACHP.

Archaeological Resource Protection Act (ARPA)
16 USC § 470aa *et seq* (1979)

The RPA addresses archeological and historic data preservation (AHDP). AHDP is directed towards the preservation of data that would otherwise be lost as a result of Federal construction or other Federally-licensed or assisted activities. It authorizes the US Department of Interior (DOI) to undertake recovery, protection, and preservation of archaeological or historic data. If a Federal agency determines that a project may cause irreparable damage to archaeological resources, that agency is required to notify the DOI in writing.

American Indian Religious Freedom Act (AIRFA)
42 USC § 1996 (1978)

This act sets forth Federal policy to preserve and protect the religious freedoms of Native Americans. The policy recognizes religious practices as an integral part of the culture, tradition, and heritage of Native Americans. Therefore, Native Americans are guaranteed the right of freedom to believe, express, and exercise their traditional beliefs which includes, but is not limited to, access to sacred sites, including cemeteries; use and possession of sacred objects; and freedom to worship through ceremonial and traditional rites.

Native American Graves Protection and Repatriation Act of 1990 (NAGPRA)
25 USC §§ 3001 - 3002 (1990)

This Act sets forth the Federal policy which addresses the rights of Native Americans to retain possession of certain human remains and cultural items with which they are affiliated. This law is applicable to any intentional excavations and/or unintentional discoveries which occur on Federal land. Prior to excavation of human remains and cultural items, or immediately upon their inadvertent discovery, potentially affiliated tribe(s) or organization(s) are to be consulted to ensure appropriate disposition of and control over the remains and objects. A draft of regulations implementing the law is currently in progress.

Endangered Species Act (ESA)
16 USC § 1531 *et seq* (1973)

The ESA is intended to prevent further decline of endangered or threatened species of plants and animals and to restore these species and their habitats. Identification of endangered species is found in 50 CFR Parts 17 and 402. If a project may impact a threatened or endangered species or their habitats, a formal consultation with the US Fish and Wildlife Service (FWS) must be conducted. Legal protection is afforded those plants and animals listed as endangered or threatened by the FWS and the National Marine Fisheries Service (NMFS). Section 7 of the Act requires that a proposed major Federal action be evaluated by the FWS and/or the NMFS for its potential to affect listed species or critical habitat. In compliance with the “Section 7 Consultation” process, the FWS and/or NMFS evaluates a biological assessment prepared by the Federal agency proposing the action and issues a “biological opinion” as to whether the proposed action is likely to jeopardize listed species or critical habitat.

Bald and Golden Eagle Protection Act
16 USC § 688 *et seq*

The Bald and Golden Eagle Protection Act makes it illegal to take, pursue, molest, or disturb American bald and golden eagles, their nests, or their eggs anywhere in the US. A permit from the USDOI is required if it is necessary to relocate a nest. If a nest is found in the project area, consultation with the USDOI regarding the correct procedures must occur.

Marine Mammal Protection Act (MMPA)
16 USC § 1361 (1972)

The MMPA offers protection similar to the Endangered Species Act to marine mammals. The Act authorizes the National Oceanic and Atmospheric Administration (NOAA) and the NMFS, to review proposed federal actions to assess potential impacts. Marine mammals also are included in Section 7 of the ESA and are part of the NMFS consultation process.

Fish and Wildlife Coordination Act
16 USC § 661 *et seq*

The Fish and Wildlife Coordination Act requires that fish and wildlife conservation receives consideration and is coordinated with water resource development programs through planning, development, maintenance, and coordination of wildlife conservation and rehabilitation. This act applies whenever the waters of any stream or other body of water greater than or equal to 10 acres in surface area is proposed or authorized to be modified for any purpose by any department or agency of the US, or any public or private agency under Federal permit or license.

Migratory Bird Treaty Act
16 USC § 703 *et seq*

The Migratory Bird Treaty Act is intended to protect birds that have common migration patterns among the US, Canada, Mexico, Japan, and the former Soviet Union. The Migratory Bird Treaty Act makes it illegal to "kill any migratory bird", or disturb nests or eggs, except as permitted by the act.

Executive Order 11988, Floodplain Management
Executive Order 11990, Protection of Wetlands

Executive Order 11988 requires Federal agencies to develop procedures that consider potential flood hazards and floodplain management criteria when undertaking a project in a floodplain area, and avoid floodplain impacts to the fullest extent practicable. Executive Order 11990 requires Federal agencies to consider the protection of wetlands when choosing a site for the Proposed Action. In addition, Executive Order 11990 allows for a Finding of No Practicable Alternative (FONPA) when there are no practicable alternatives to minimize harm to wetlands from such use.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Super Fund)
26 USC § 4611 *et seq* (1980), and
Super Fund Amendment and Re-authorization Act of 1986 (SARA)
PL 99-499, 100 Stat/613

CERCLA provides for the liability, compensation, cleanup, and emergency response for hazardous substances released into the environment, including the cleanup of inactive hazardous waste disposal sites. It includes provisions for reportable quantities, penalties, response authority, civil penalties and awards, employee protection, claims procedures, guidance for federal facilities, cleanup standards, and the National Contingency Plan. CERCLA provides that past and present owners of a contaminated site, as well as the generators and transporters who contribute hazardous substances to a site, shall be liable for all costs of removal or remedial action that is undertaken by the US government, a state, or any other person and for damages for loss of natural resources. SARA enacted extra provisions and reinforces CERCLA in providing extra funding for long-term remedial measures to clean up specific sites that are a threat to human health and emphasizes use of treatment technologies, and meeting state requirements and standards of cleanup.

Occupational Safety and Health Act (OSHA)of 1970
29 USC § 651 (1970)

The goal of OSHA is to assure safe and healthful working conditions, free of recognized hazards that could cause serious injury or death, for the working men and women in the nation. Employers must comply with the safety and health standards established under the act. Provisions of this act govern many aspects of the construction and operation of a proposed spaceport. Administration of this Act is the joint responsibility of the Department of Labor (Occupational Safety and Health Administration) and the Department of Health, Education, and Welfare (National Institute for Occupational Safety and Health). OSHA now has primary responsibility for determining priorities, setting standards, enforcement, operating a national record-keeping and reporting system, providing employer/employee education, approving state plans, and awarding state grants. OSHA has a supportive role in nearly all these activities, and performs health and safety research, industry-wide studies, hazard evaluations, toxicity determinations, and annually publishes a list of toxic substances.

OSHA also regulates certain hazardous materials in Subpart H of 29 CFR § 1910. Some of these are: acetylene, compressed gases, dip tanks containing flammable or combustible liquids, explosives and blasting agents, flammable and combustible liquids, hydrogen, oxygen, nitrous oxide, spray finishing using flammable and combustible materials, storage and handling of anhydrous ammonia, storage and handling of liquefied petroleum gases. Certain toxic and hazardous substances are also regulated under OSHA: acrylonitrile, air contaminants, asbestos, ethylene oxide, lead, vinyl chloride, and many others.

The Hazardous Materials Transportation Act, as amended
49 U.S.C. App. §§1801-1812, as recodified at Title 49, Ch. 51,
49 U.S.C. §5101 et seq.

The Hazardous Materials Transportation Act, as amended, covers the safe packaging, placarding and documentation of hazardous materials in transportation. Regulations are found at 49 CFR Part 171-181. Any hazardous materials and fuels used in launch vehicles and payloads must be transported in accordance with these regulations.

The Department of Transportation (DOT) Act of 1966 Section 4(f)
49 U.S.C. §303(c)

The Act provides that the Secretary of Transportation may not approve the use of publicly owned land from a park, recreation area, wildlife or waterfowl refuge or land from an historic site unless he/she finds that 1) There is no feasible and prudent alternative to the use of such land and 2) There has been all possible planning to minimize harm from such use.

### 1.4.2 State of California Regulations

California Clean Air Act (CCAA)

California Statute (1988) Chap 1568
Amending Sections in Health and Safety Code 39607 *et seq*

The CCAA requires all stationary sources to undergo pre-construction review and requires such sources to obtain permits from the local Air Pollution Control District (APCD). Under the Act, no person may install, construct, modify, or engage in any activity which may cause the issuance of air contaminants without first obtaining a permit from the APCD. The Act also prohibits the discharge of air contaminants from any source that may cause injury, nuisance, or annoyance to the public or damage to property, or exceeds certain capacity limits.

The State agencies primarily responsible for controlling air pollution are the California Air Resources Board (CARB), under jurisdiction of the California EPA (CalEPA) and local or regional air pollution control districts and air quality management districts. The California Health and Safety Code Division 26, Air Resources, contains the guidance for the CCAA and its amendments. The CCAA was designed to provide additional state ambient air quality planning at a time when the Federal Clean Air Act NAAQS attainment deadlines appeared to be inconsistent with California's efforts to address serious air quality problems in the state.

While California already has an air quality permit program in place, it must also comply with Title V of the Clean Air Act (CAA) of 1990 which goes into effect in November 1995. Title V tries to address the concerns about the lack of flexibility in current air permitting regulations. Title V provides the County and Local environmental communities the opportunity to rethink the environmental system. Regulation proposals are being provided which have environmental benefit while allowing increased operational flexibility and less burdensome administrative procedures.

In November, 1993, Santa Barbara County adopted the final Part 70 regulation (Regulation VIII) as required by Title V of the CAA amendments. The Environmental Protection Agency (EPA) has one year to approve the final regulation and Vandenberg AFB's Part 70 Permit application is due within one year of the regulation approval in November, 1995. The Part 70 Permit is a facility wide permit which is Federally enforced and locally implemented. There are many issues with respect to the existing permit program, permit review, modification thresholds, potential to emit, toxic emissions under Title III, and operational flexibility which need to be resolved in the regulatory community and understood by the permit holder. All Title V emission sources would be identified in this application and recertified annually. Santa Barbara County permitted emissions are also reported annually.

<u>Toxic Air Contaminants Law, 1983</u>
Health & Safety Code §§ 39650 *et seq*

This law establishes a program to evaluate and control potential air toxins. Penalties are provided for violations of the controls on emissions of identified air toxins. The California Air Resources Board (CARB) has the primary responsibility, and has identified sixteen categories of toxic air contaminants: inorganic arsenic, asbestos, benzene, cadmium, chloroform, ethylene dibromide, ethylene dichloride, hexavalent chromium, dibenzo-p-dioxins and chlorinated dibenzofurnas, carbon tetrachloride, ethylene oxide, methylene chloride, vinyl chloride, nickel, perchloroethylene and trichloroethylene. Following 1990 amendments, these categories account for more than 189 Hazardous Air Pollutant Standards (HAPS).

<u>Toxic "Hot Spots" Information and Assessment Act</u>
Assembly Bill [AB] 2588 (1987)

The Toxic "Hot Spots" Information and Assessment Act requires the gathering of information on air emissions of hazardous substances from facilities that create localized airborne concentrations, or "hot spots," of such substances. A facility is subject to the Act if it was listed in any toxic air emissions survey, inventory or report, if it manufactures, formulates, uses or releases any substances on the

Act’s list, or if it has the potential to release criteria pollutants - Total Organic Gases, particulate matter (PM), nitrogen oxides (NO) or sulfur oxides (SO), in certain amounts. A facility subject to the Act must complete a detailed inventory of its emissions every two years. Risk assessments are to be prepared by facilities that have submitted emissions inventories, according to a priorities list set by the APCD. The risk assessment is a comprehensive analysis predicting dispersion of hazardous substances in the environment, the potential for human exposure, and resulting individual and population-wide health risk.

For any new source of emissions from a facility, the APCD performs a new risk analysis. If the APCD determines there is a significant risk associated with the new emissions, then the operator of the facility (Vandenberg AFB) must conduct an airborne toxic risk reduction audit and develop a plan to implement airborne toxic risk reduction measures that will result in the reduction of emissions from Vandenberg AFB to a level below the significant risk level. Clean Air Act Amendments Title III has control requirements for toxic emissions and also has risk management plan requirements for accidental releases of toxic emissions.

The Toxic “Hot Spots” Information and Assessment Act requires Vandenberg AFB to prepare an Emission Inventory Plan (EP) which identifies all sources and/or processes and their potential emissions. Once an EP has been approved by the Santa Barbara Air Pollution Control District (APCD), those potential emissions must be quantified (i.e., implementation of the EP to produce the Emission Inventory Report (EIR)). AB 2588 then requires a risk analysis to those sources identified by the APCD and public notification of the results. The APCD performs the risk analysis and if the APCD determines there is a significant risk associated with emissions from Vandenberg AFB, then the Base must conduct an airborne toxic risk reduction audit and develop a plan to implement airborne toxic risk reduction measures that will result in the reduction of emissions from Vandenberg AFB to a level below the significant risk level.

<u>California Hazardous Waste Control Law (HWCL)</u>
Health & Safety Code § 25100 *et seq* (1972)

The HWCL imposes obligations on facilities from the generation to the disposal of hazardous waste. California's HWCL applies to Federal facilities insofar as the laws require permitting, inspections, and monitoring. State waste disposal standards, reporting duties, and the submission to state inspections are required of Federal facilities. The California HWCL pre-dates the Federal RCRA. The HWCL directed the California Department of Toxic Substances Control (DTSC) to adopt regulations that would allow California to obtain authorization to administer a state hazardous waste program in lieu of RCRA. The EPA and DTSC have entered into an agreement under which the DTSC performs certain RCRA functions for EPA, including some enforcement and permitting. Nonetheless, both agencies currently enforce hazardous waste management regulations in California. HWCL directs the DTSC to adopt regulations to implement HWCL. DTSC has adopted substantial regulations and re-codified these in 1991. The objective of this re-codification was to conform closely in format to RCRA, in order to gain EPA authorization. It is important to understand that a material may be considered hazardous under the California HWCL while it may not be hazardous under the Federal RCRA. In this case the hazardous waste(s) are called “non-RCRA hazardous wastes.”

<u>California Coastal Act</u>

California’s coastal program, as authorized by the Federal CZMA, is detailed in the California Coastal Act. The goal of this statute is to protect, maintain, and where feasible, enhance and restore the overall quality of the coastal zone. In addition, the statute strives to assure priority for coastal-dependent and coastal-related development over other development along the coast.

In general, the statute outlines the coastal zone as being 1,000 yards from the mean high tide line. In significant coastal estuarine, habitat, and recreational areas, the line extends inland to the first major ridgeline paralleling the sea or 5 miles from the mean high tide line, whichever is less. In developed urban areas, the line is generally less than 1,000 yards from the mean high tide line. Projects within the coastal zone must undergo review with the California Coastal Commission.

Regional Water Quality Control Board, (WQCB) Resolution No. 83-12 and Order No. 83-60

The State of California Regional Water Quality Control Board (WQCB), Central Coast Region, regulates all domestic wastewater treatment systems discharging effluent to the surface (including evaporation/percolation ponds), in accordance with the Central Coast Basin Plan, dated March 14, 1975. Resolution No. 83-12 of the WQCB covers amendments to the Central Coast Basin Plan and contains specific recommendations for community sewage system design. Community systems are defined as having sanitary wastewater discharges of greater than 2,500 gallons per day (average daily flow). Certain larger sewage systems on Vandenberg AFB are operated in accordance with WQCB Order No. 83-60.

California Porter-Cologne Water Quality Act
California Water Code § 13000 *et seq*

The California Porter-Cologne Water Quality Act defines a water quality control program for the state, which includes guidelines for long range resource planning, including programs for ground water, surface water, and reclaimed water. The Porter-Cologne Act is also designed to protect Coastal Marine water quality and to control discharges to wetlands, estuaries, and other biologically sensitive areas. The act is also administered by the WQCB.

California Endangered Species Act (CESA),
Fish & Game § 2050 *et seq* (1957), and
California Native Plant Protection Act (NPPA)
California Food & Agricultural § 80000 *et seq*

CESA and NPPA are administered by the California Department of Fish and Game. They are designed to protect the rare, endangered, and candidate species of plants and wildlife. Candidate species are those accepted for review by the state for inclusion in the list of threatened or endangered species. Rare plants are those plants which may become threatened or endangered, because of decreasing numbers of restrictions in habitat. The US Air Force is not obligated to protect state-listed threatened or endangered species. However, Air Force policy is to work cooperatively with the California Department of Fish & Game.

California Code of Regulations, Title 22, Division 4, Environmental Health
22 California Code of Regulations § 66001 *et seq*

These are the substantial regulations adopted by the California Department of Toxic Substances Control, now under CalEPA, to implement the Hazardous Waste Control Law (HWCL). These regulations were re-codified in 1991 to conform closely to RCRA format, while providing California its own, more stringent hazardous waste management program. The DTSC is working to obtain authorization to enforce the State's program in lieu of RCRA.

### 1.4.3 County Regulations

Santa Barbara County Air Pollution Control District (APCD)
APCD Health & Safety § 40000 *et seq*

Air Districts (Air Pollution Control Districts and Air Quality Management Districts) have broad authority to control non-vehicular air pollution. Under state law, the air districts have the primary responsibility for control of air pollution, and may set stricter standards than set by state statute or CARB rules. Indeed the California Supreme Court has recognized their authority to regulate beyond the state ambient air quality standards and statewide toxic air contaminant program.

State law establishes detailed procedures to be followed by air district governing boards for adoption or amendment of district rules. Notices, informal workshops, public hearings, publication, public comment, and specific findings by a governing board are necessary. The district governing board must find the action is necessary, authorized, clear, consistent with other laws and regulations, and does not impose the same requirements as an existing state or federal regulation. (Health & Safety Code § 40727).

Health & Safety Code § 42300 and § 40506(a) directs all air districts to establish a permit system requiring any person who plans to build, alter, replace or operate any article, machine or other contrivance capable of emitting air contaminants to first obtain a permit from the district in which the source is located. This is interpreted to include permitting of air pollution control equipment. Districts are authorized to impose fees for processing permit applications and for annual permit renewal. These fees are frequently substantial, since most of the costs of air district programs are financed through permit fees. A district may enter into a contractual agreement with a permit applicant to set a specific fee or reimbursement procedure.

The Federal CAA and EPA regulations require states to adopt, as part of their state implementation plan for attainment and/or maintenance of the Federal NAAQS, a pre-construction review program applicable to major new sources and to modifications of existing major sources (42 USC § 7410 and § 7475, and 40 CFR §§ 51-52, respectively). The pre-construction review program in non-attainment regions is called a “new source review” (NSR), and in attainment regions “prevention of significant deterioration’ (PSD). NSR rules typically contain the following two provisions:

1. A threshold level for net emission increase for each air contaminant from the new/modified source, beyond which NSR requirements apply.

2. Emission offsets must be proposed by applicant and approved air district. An offset is a reduction of emissions at the existing stationary source exceeding the increase in emissions from the new/modified source.

### 1.4.4 DOD, Air Force, and Vandenberg AFB Regulations

<u>DOD Directive 6050.1 (AF Environmental Directive)</u>

This high-level directive forms the Department of Defense specific policy guidance within the Department for carrying out provisions of the National Environmental Policy Act.

<u>Air Force Regulation 19-2 (AF Environmental Impact Analysis Process)</u>

The Air Force provides further guidance in carrying out NEPA requirements for Air Force programs and on Air Force bases. This guidance applies to all commercial space launch programs to be conducted on Air Force bases.

### 1.4.5 DOT Regulations

The Commercial Space Launch Act of 1984, 49 U.S.C. App. §§ 2601-2623, as recodified at 49 U.S.C. Subtitle IX-Commercial Space Transportation, ch. 701 - Commercial Space Launch Activities, 49 U.S.C. §§ 70101-70119 (1994) (The Act), authorizes the Secretary of Transportation to license and otherwise regulate commercial space launch activities and the commercial operation of launch sites carried out within the United States or by its citizens. The Act requires that this responsibility be exercised to protect the public health and safety, safety of property, and national security and foreign policy interests of the United States 49 U.S.C. §70101(b)(3). The Secretary's responsibilities under the Act, including licensing commercial launches and the operation of launch sites, as well as the obligation to encourage, facilitate and promote establishment of a competitive United States commercial space transportation industry, are implemented by the Department of Transportation's Office of Commercial Space Transportation (OCST). Licensing is a "major Federal action", as defined by the Council on Environmental Quality (CEQ) Regulations (40 C.F.R. § 1508.18). OCST is ultimately responsible for any environmental review documentation to projects under its authority (40 C.F.R. § 1506.5).

<u>DOT 5610.1C (Procedures for Considering Environmental Impacts)</u>

This order establishes procedures for consideration of environmental impacts in decision making on proposed Department of Transportation (DOT) actions. The order provides instructions for implementing NEPA, the CEQ regulations, and other Federal environmental regulations and provides that information on environmental impacts of proposed actions will be made available to public officials and citizens through environmental impact statements, environmental assessments or findings of no significant impacts.

## 2.0 PROPOSED ACTION AND ALTERNATIVES

### 2.1 Description of the Proposed Action

The major federal actions in this project are (1) the USAF's proposed lease to WCSC of the Payload Preparation Room at SLC-6 for use as an Integrated Processing Facility and land adjacent to SLC-6 for development of the Spaceport Launch Facility and (2) the possible grant by DOT of a license to operate a commercial spaceport. The proposed project is to develop a rocket launch and support system, the California Spaceport, that can provide facilities and support services to commercial, university, and government organizations (CCSI 1994). Throughout this environmental assessment, the proposed project will be referred to as the preferred alternative or as the "Spaceport" (Figure 2.1). It is intended that the Spaceport be capable of supporting all available commercial launches planned for launch within the coming years. This environmental analysis will assume a worst case frequency of 24 launches per year of the largest launch vehicle that would be capable of using the facility.

As a Federal action, this proposed project would be licensed by OCST and implemented under the authority, guidance and concurrence of the US Air Force, 30th Space Wing (30SW), headquartered at Vandenberg AFB, and the US Department of Transportation (DOT), Office of Commercial Space Transportation (OCST). OCST oversees and regulates the commercial operation of launch sites through its licensing process. In addition to conducting Air Force Space Command (AFSPC) operational launches, the 30 SW operates the Western Range (WR) and provides host base support at VAFB (USAF 1993b). The Western Range includes government and commercial space, ballistic, and aeronautical operations.

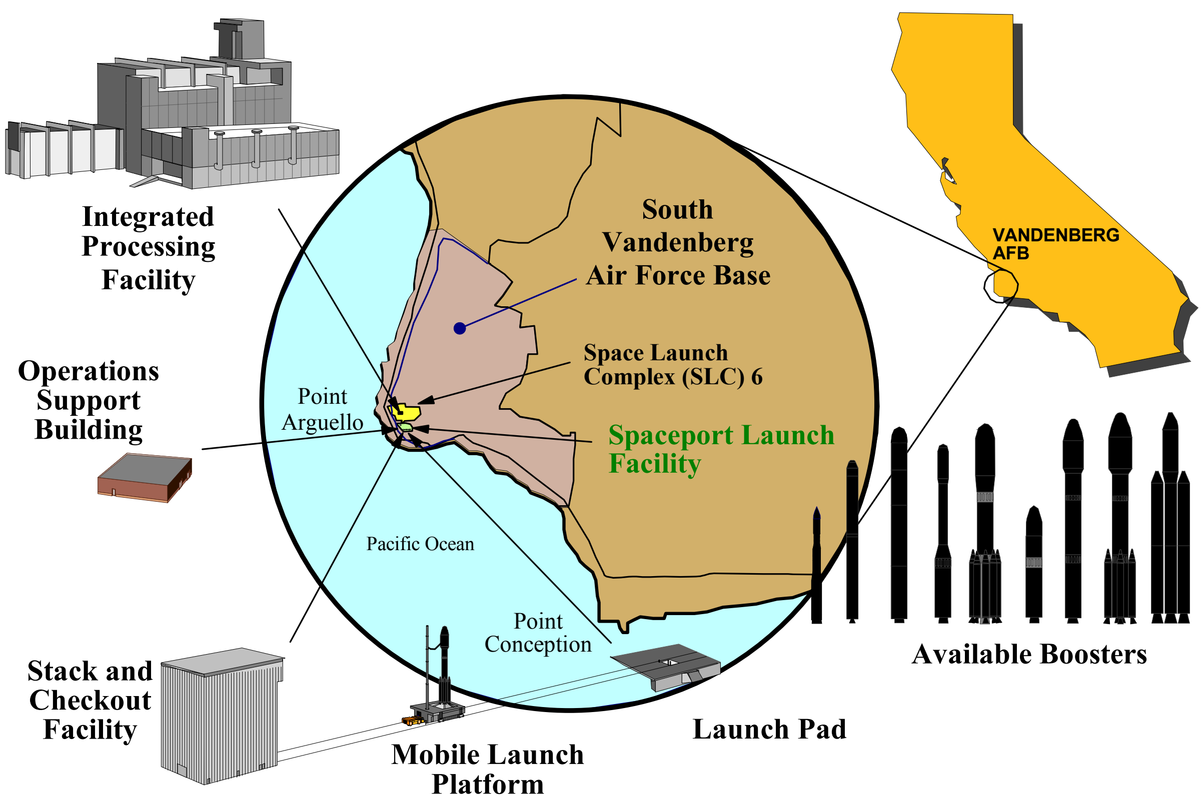


Figure 2.1. Components of the California Spaceport

The primary function of the proposed Spaceport would be to launch payloads into polar orbit. It would consist of two major facility components. These would include (1) an Integrated Processing Facility

(IPF) with room for assembly of launch vehicles and preparation of payloads, and (2) a Spaceport Launch Facility (SLF) with a central launch pad serviced by two Stack and Checkout Facilities (SCFs) and an Operations Support Building (OSB). The Spaceport would also provide service and control systems. The facility is designed to accommodate a variety of small-sized to medium-sized launch vehicles, while remaining modest in size, and low in cost for operations and maintenance.

WCSC has developed the Spaceport concept in cooperation, and in consultation, with a consortium of 21 aerospace and support companies, the US Air Force, and the State of California (CCSI 1994). It is a goal of this team of industrial entities and government agencies to reduce the high cost of launch operations and to streamline traditional processes and procedures through state legislation and cooperative efforts.

This environmental assessment will discuss the construction of the Spaceport and its subsequent operation. In general terms, operations include spacecraft and booster fueling, testing, preparation and launching activities. For completely developed, operational rocket vehicles, a full complement of information is available and incorporated into this EA. Some details of specific rocket systems which have not been fully developed, such as the PA-2, AMROC Aquila, and the ORBEX, will not be included in this document. For the purposes of this EA, specific launch vehicles have been selected for analysis. This is based on their representativeness and the availability of safety and performance histories appropriate to address specific potential impacts. This is sufficient to evaluate the overall impacts of a fully operational Spaceport.

Section 2.1.1 describes the payload preparation area. The work area, called the Integrated Processing Facility, would be operated in the Government's excess Payload Preparation Room (Bldg. 375) at SLC-6. This large building was originally built to support the simultaneous preparation of up to nine payloads for the Space Shuttle. A Test Control Center (TCC) and Launch Control Center (LCC) would also be established in the building and connected through telecommunications systems to the launch facilities.

Section 2.1.2 describes the new launch facilities. The Spaceport Launch Facility (SLF) is proposed to be constructed 0.79 km (0.49 mi) to the southwest of the SLC-6 launch mount. Approximately 40.5 ha (100.0 ac) would be leased from the Air Force for the launch facility. The development, including a launch pad, two SCFs, an Operations Support Building (OSB), utilities, a new access road and rail access would cover approximately 5.3 ha (13 ac) of this area. The remaining leased land would remain undeveloped. The large size of the leased area is required to prevent outside interests from constructing inhabited structures within the explosive limits of the Spaceport, thereby severely limiting its flexibility.

Section 2.1.3 describes the concept of operations for deployment of the Spaceport facilities. Section 2.1.4 provides the Spaceport development and construction schedule. Section 2.1.5 describes eight of the potential launch vehicles which would be processed in at least part of the Spaceport.

Section 2.2 introduces the alternatives to the proposed action. This includes the No-Action alternative, alternatives outside California, and alternatives at Vandenberg AFB.

### 2.1.1 Integrated Processing Facility

WCSC would provide the facilities and support for the preparation of launch vehicles and satellite vehicles (CCSI 1994). These services would be performed in the Integrated Processing Facility, which is the former Payload Preparation Room (PPR), also known as Bldg. 375, at SLC-6. The PPR is excess and would be leased from Vandenberg AFB in anticipation of the requirement for an IPF. Building 375 has been maintained in a standby status and partially used for other Air Force programs until February 1994. Figure 2.2 is a photo of Building 375.

The development of the IPF offers several advantages. First, it was designed to handle large payloads and has been maintained in good condition since 1986. Second, this facility includes ample user operations support areas and is fully interconnected with the Western Range through the Fiber Optics Transmission System. Third, multiple programs can function simultaneously in the IPF, thereby reducing the operations and maintenance burden on individual users.

The existing PPR would be optimized for flexible use by WCSC. There is sufficient area within the building to allow the assembly of major components of launch vehicles. The entire payload preparation area can be sealed and maintained as a "clean room" to the degree required to protect payloads and critical instruments. Figure 2.3 illustrates the floorplan and a typical use of the IPF.

Figure 2.2. Integrated Processing Facility (Bldg. 375)

Three Test Control Centers (TCCs) would be located in an administrative area of the IPF. Each center would contain communications consoles and provisions for a PC-based system. These would provide remote control capability to the Aerospace Ground Equipment (AGE) for check-out of integrated systems for launch rehearsals and actual launches, including fuel loading, vehicle testing, launch rehearsal and pathfinder operations.

A Launch Control Center (LCC) would also be located in the IPF. This would eliminate the need for each user to establish temporary and redundant launch control facilities in mobile trailers. In addition, safety regulations, cost considerations, and environmental concerns make it desirable to locate the LCC in an existing facility, such as the IPF, that is geographically separated from the launch complex.

The LCC would be connected to the Spaceport Launch Facility by communications, video, and command/control circuits. It would contain a TCC as a subset of its functional capability. Space would be provided for personal computers and communications facilities required to track and record the status of the launch vehicles, payloads, and launch activities. Work space would also be provided for the launch manager, the Range Flight Safety Officer, and payload managers. During a launch, an estimated 18 persons could be in the Launch Control Center.

No major modifications are anticipated to the exterior of the IPF and only minor changes are planned for the interior of the building. For instance, the existing wastewater treatment facility would be employed. Some modifications to the IPF are currently underway as part of the Air Force upgrade and modernization program. Additionally, limited facility plant component replacement and reconfiguration is necessary to make the IPF an economic facility for its new mission. These upgrades, modernizations and reconfigurations are listed below:

a. The large chillers would be reconfigured to the limited loads that are expected. The Air Force and WCSC are proposing to reduce the chiller unit size from four 320 ton units to two 160 ton units. The smaller units would also be equipped with modern control equipment that allows stepping the chillers through three levels of capacity: 50 tons, 100 tons, and 160 tons. The coolant in the chillers would be replaced with more environmentally acceptable refrigerants. The chillers currently use Freon 12, or CFC-12, which has an ozone depleting potential (ODP) rating of one. This coolant would be recovered, recycled and replaced with Freon 22, or HCFC-22 (ODP = 0.1). Existing heating systems would be converted to propane from previously existing fuel oil units. Other unneeded systems would be turned off.

b. A 7.5 ton bridge crane would be installed on existing rails in the Transfer Tower of the IPF. This crane would provide a critical alternate access to the building that does not presently exist. Currently, the Vehicle Checkout Facility is the only entrance for delivery of units for processing. This alternate access would be necessary if one operation blocks access to the remaining portions of the building by occupying space in front of the facility doorway. The addition of this crane would not alter the capabilities of the existing building.

The area of the facility maintained as a cleanroom would be reduced to the minimum space required by customers. This cleanroom capability could include Cell #2, Cell #3, the Payload Encapsulation Area, Levels 69, 89, 129, and 165, and their associated stairwells (Figure 2.3). Levels 69, 89, 129, and 165 are floors within the IPF. The number designation for each level reflects its elevation relative to the SLC-6 launch mount, which is Level 100.

An estimated seven persons would be assigned to the IPF by WCSC or its contractors. In addition, when organizations bring their launch vehicles and satellites into the IPF, they would supply their own workforce. The total number of persons from all companies working in the IPF could rise to 100 during peak use of the building.

A minimum of specialized equipment would be permanent to the IPF. Clean room fixtures such as tables, stools, stands, and cabling would be provided. Organizations bringing launch vehicles and payloads into the IPF would also bring in specialized test equipment, hand tools, jigs and fixtures.

Initial activities would include the restoration of telephone systems, alarm systems, and existing utilities. WCSC desires to create the full capability of the IPF by July, 1995. This is required to begin processing payloads for an expected first launch from the Spaceport Launch Facility in 1996. The use of the IPF, an existing structure, would be to support space vehicle integration and preparation. This is the function for which the IPF was designed and would not require a further commitment to irreversible impacts or loss of irretrievable resources. In the event that the Spaceport ceases operations, the IPF would be returned to the Air Force.

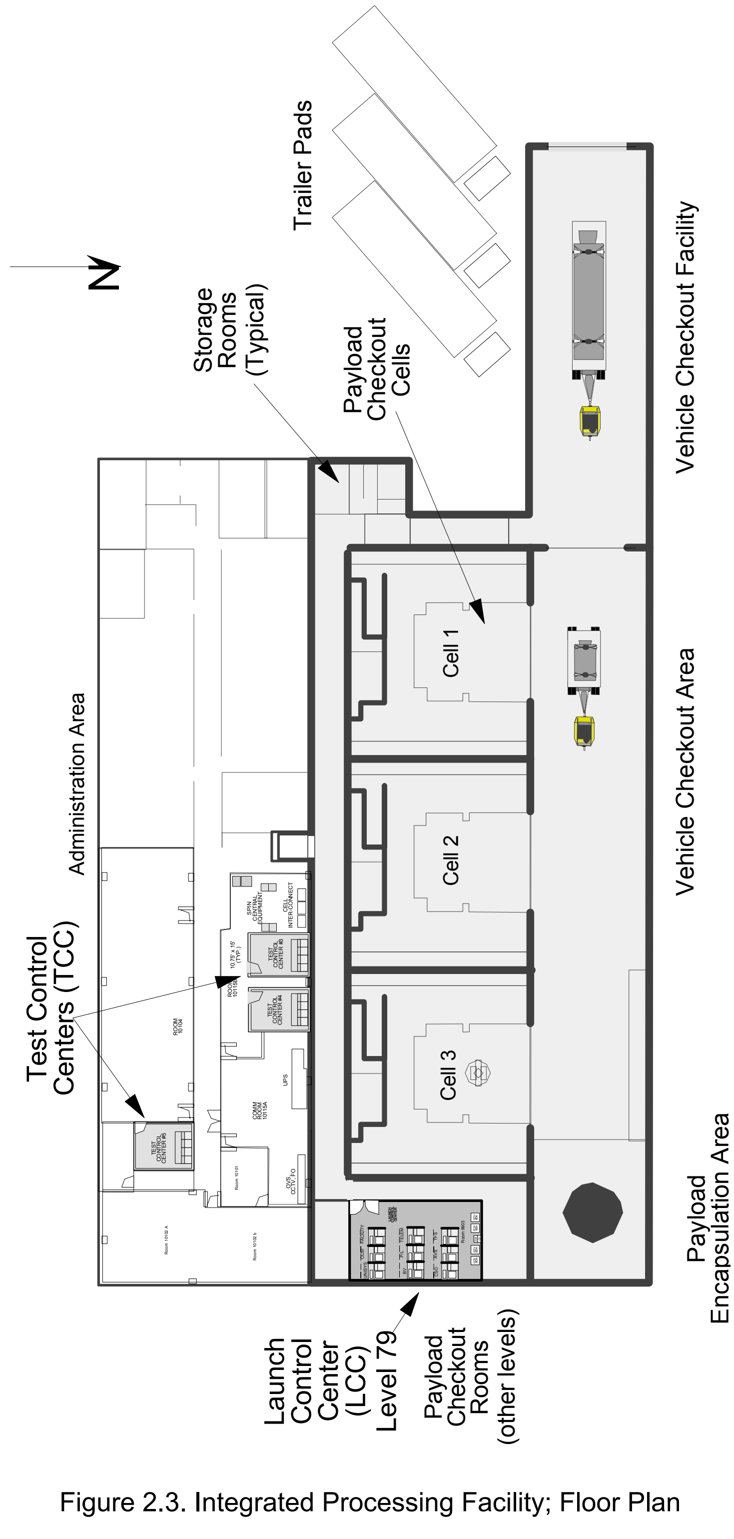


Figure 2.3. Integrated Processing Facility; Floor Plan

For purposes of this EA, the example workload in the IPF is a communication satellite processing and launch campaign. It is necessary to use a generalized, worst-case operational scenario to describe the activities planned at the IPF because details of future programs that may require the use of the IPF are not known at the present time. The IPF would be marketed as a multi-customer facility for the simultaneous processing of multiple space vehicles. While the IPF was originally designed to service and process up to three Space Shuttle cargo bay's full of payloads, most of the satellites and launch vehicles planned for launch from the Spaceport are small, relatively benign vehicles. The example workload is intended to show a reasonable but substantial level of activity for the IPF. Processing operations are normally limited to final assembly operations and launch readiness testing of the satellites. Major manufacturing of satellites is performed in off-site factories and plants, located around the United States. Potential environmental impacts are limited to those associated with these final assembly and processing activities.

A total of forty satellites would be prepared for launch in the IPF during a 21-month period. One satellite per week would be prepared and installed on a launch dispenser. When five satellites have been completed and mounted on the dispenser, the satellites would be fueled with approximately 100 pounds (11.5 gallons) of hydrazine per satellite. The entire dispenser would be covered by a shroud and moved to the launch pad. The processing scenario represents only a potential worst-case use of the facility, as stated in the preceeding paragraphs. There would be multiple customers supported at the IPF. There would also be occasions when more than one satellite can be launched by a single booster so it should not be assumed that the processing of 40 satellites necessarily equates to 40 launches. For instance, in this example, the 40 satellites would be launched by eight boosters. It should not be assumed that the launch campaign used as a test case here would necessarily be processed as described. In the absence of a fully defined mission for the IPF, it is desirable to bound the scope and type of processing that may be encountered. The IPF can also support the processing of satellites not intended for launch at the Spaceport. This use is consistent with the original intended use of such a facility because processing requirements for space hardware are uniform and well understood, regardless of launch site.

Hydrazine would be obtained from the VAFB hydrazine storage facility. Issues related to the transportation of propellants are the responsibility of the individual users. However, the Spaceport would assist users in obtaining the appropriate transportation permits and coordinating with applicable agencies. Transportation of hazardous materials on base would be in strict accordance with Air Force regulations and local policies. Existing hydrazine transportation corridors would be used. Acquisition and disposition of hydrazine would be evaluated for each individual launch system in the supplemental environmental impact analyses by each Spaceport user. The Air Force recognizes its responsibility to control hazardous operations on Vandenberg AFB. The transportation, storage and handling of all types of hazardous and toxic commodities have been exhaustively analyzed in separate environmental and safety documents. Users of the Spaceport, as do all Vandenberg AFB users, would provide copies of all hazardous procedures, including those associated with rocket propellant operations, to the 30 SW Safety Office for review and approval well in advance of any proposed operations. Operations will be conducted under direct supervision of qualified safety personnel from the user organization and the 30 SW Safety Office. At no time would the Air Force relinquish its ultimate authority and responsibility for the safe conduct of hazardous operations on Vandenberg AFB. In addition, Spaceport operators would be responsible to the Air Force, and to customers of the Spaceport, for the safe conduct of hazardous operations within the confines of the Spaceport. Customer operations involving the use of hazardous materials would be coordinated through the Spaceport operations center, and conducted with oversight from Spaceport and Air Force safety personnel, as required.

Existing storage capacity for hypergolic fuels and oxidizers at Vandenberg AFB are more than adequate to support the requirements of Spaceport customers. No new storage capacity would be added to existing Air Force capabilities, nor would new storage facilities be required at the Spaceport.

### 2.1.2 Spaceport Launch Facility

The second facilities component of the California Spaceport is the Spaceport Launch Facility, shown in Figure 2.4. The SLF would be located 0.79 km (0.49 mi) to the southwest of the launch mount at SLC-6. This Spaceport facilities would consist of a launch pad, two Stack and Checkout Facilities, an Operations Support Building, utilities services, a rail spur, and an access road. Figure 2.5 shows the proposed layout of the facilities including rail access from the SLC-6 spur along Coast Road.

Approximately 40.5 ha (100.0 ac) would be leased from the Air Force for the launch facility. The SLF would be a new development that would occupy less than 5.3 ha (13 ac) of the leased area. The remainder of the leased area would remain undeveloped and undisturbed.

The development of the SLF would consist of the following steps and processes:

a. A paved access road of less than 305 m (1,000 ft) in length would provide access to the launch site from Coast Road and Road N. The width of the roadbed would be approximately 12.2 m (40 ft). Embankments would be revegetated as specified in the Vandenberg Land Management Plan to control erosion and complement the surrounding plant environment.

b. A rail spur of approximately 853 m (2800 ft) which would connect the two SCFs with the existing rail line near the motor checkout facility (Bldg. 398). The rail spur would provide a direct transportation route from the manufacturer to the Spaceport for motors and equipment. This would reduce dependence upon public road transportation corridors.

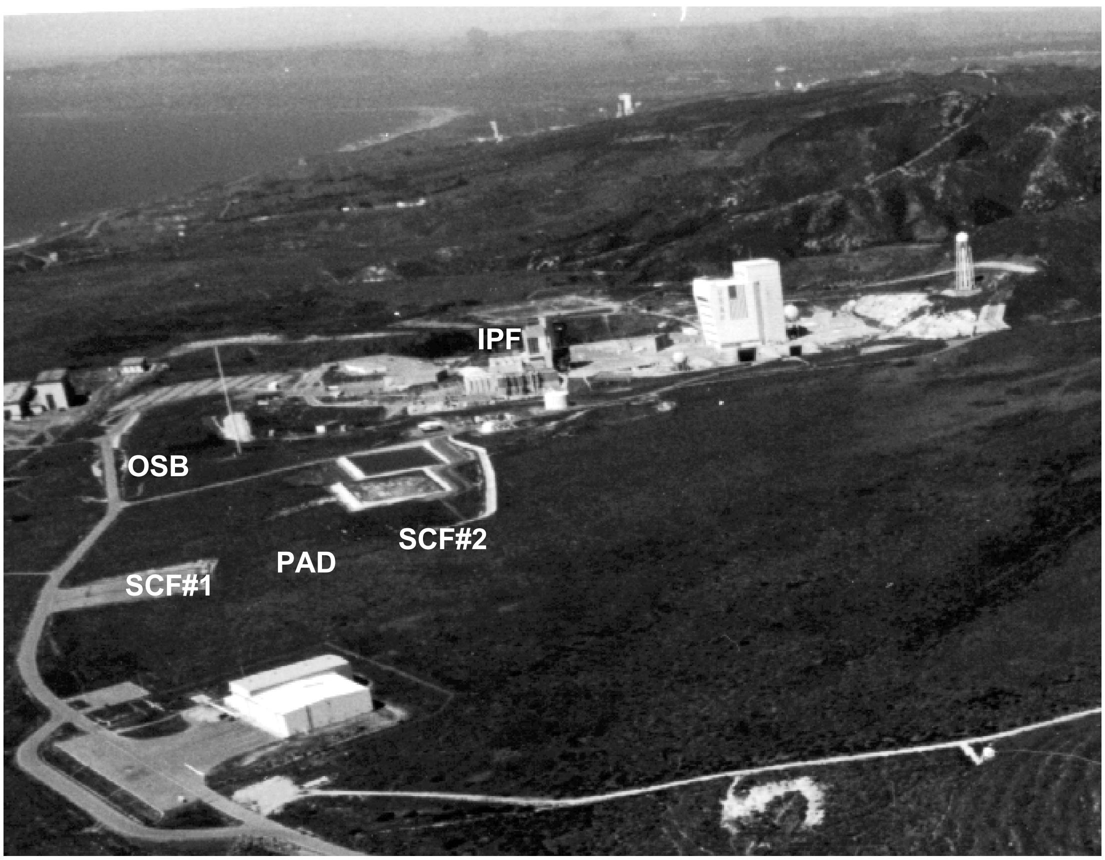


Figure 2.4. Preferred Alternative Launch Site

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Figure 2.5. Site Layout - Preferred Alternative

c. Two Stack and Checkout Facilities of approximately 622 sq m (6700 sq ft) and 50 m (165 ft) tall (Figure 2.6). The SCFs would be arrayed in an east-west orientation, approximately 102 m (500 ft) to either side of a single concrete launch pad. Mobile launch stands would move the rockets to the stand for final launch countdown activities. Access to the launch vehicle and payload would be provided by platforms within the facilities. Elevators and internal, 75 ton bridge cranes would be provided in each of the buildings. The SCFs are significantly smaller than other service towers currently present on South Vandenberg AFB or previously proposed for construction (Figure 2.7).

d. A small concrete launch stand and exhaust duct located between the two SCFs. Using one launch pad to support all launch activities allows for minimum disturbance of the landscape during construction and operations activities. The launch duct would be a nearly level concrete surface that slopes toward a curb designed to catch and retain rainwater and wash water on the pad. The launch pad would also be used to service the needs of launch vehicle providers who do not require the use of an SCF.

e. Utilities for water, power, telephone, launch control circuits, and data circuits. These would be buried in the road right-of-way and the foundation area of the SCFs and launch pad. Fiber optic cable would be used for all main trunks for controls and communications. Water usage would only be for sanitation and maintenance of the work areas; no sound suppression deluge water would be used on the complex. Water main service to the complex would be sufficient to provide fire flow as prescribed by the Vandenberg AFB Fire Department. Telephone service would include minor numbers of circuits for administrative coordination and dedicated circuits from the launch pad to the LCC located in the IPF. Three-phase, 60 hertz power would be provided to the SCFs and launch pad for portable equipment, lights, and hand tools.

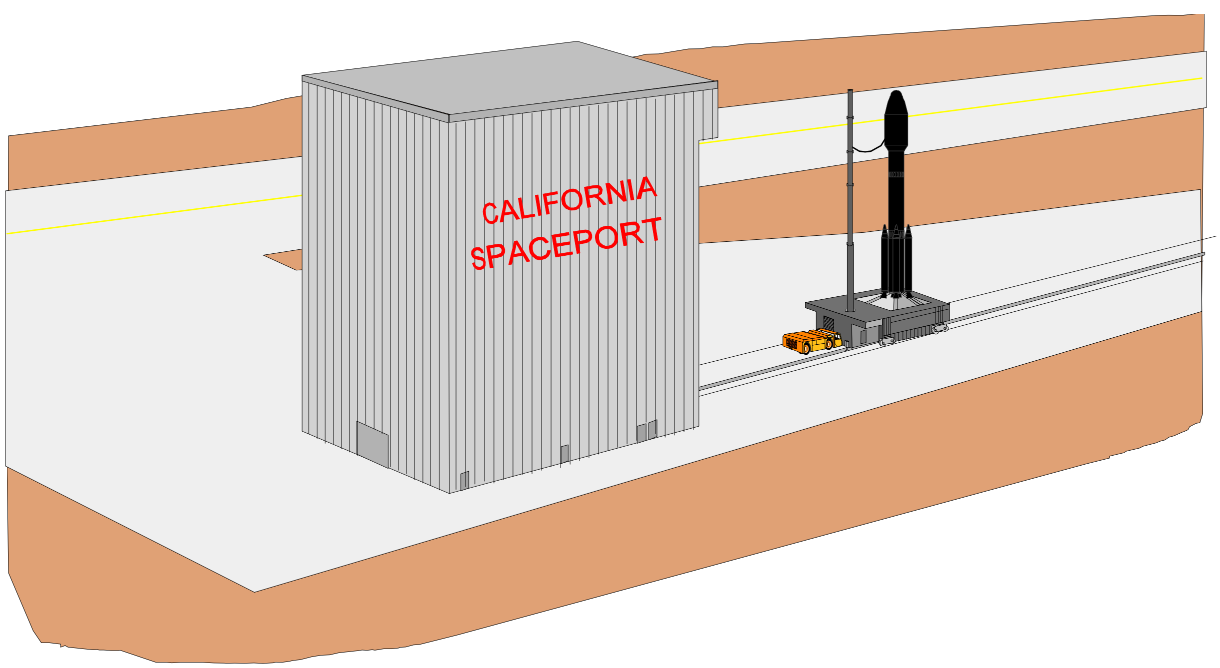



Figure 2.6. Concept of Stack and Checkout Facility

The SCFs and the launch pad would use existing wastewater treatment facilities at SLC-6. This would be connected by a sewer connection from Coast Road. Stormwater collected in the launch mount flame duct or in catchment basins would be sampled. Depending upon the results, the water may be discharged to grade or sent to the industrial wastewater treatment plant. If the capacity does not exist at the treatment plant, it may be necessary to transport the waste off-base for treatment.

f. A single story Operations Support Building of approximately 557 sq m (6000 sq ft). This would be located near the northeast corner of Coast Road and Road N. A separate area would be required to provide a safe control area, away from any hazardous operations being conducted at the SCFs or the launch pad. The general appearance of the proposed building is shown in Figure 2.8. The building would provide offices, an operations center, two TCCs, and three user areas for WCSC and its customers. Parking for 40 automobiles would also be provided.

g. Utilities. These would be extended from established Space Shuttle facilities to supply the SLF. Extensions would follow new and established roads to the site. Existing communications between SLC-6 and the Solid Rocket Motor Storage Facility (Bldg. 330) would be relocated along the Coast Road. The OSB would use existing wastewater treatment facilities at SLC-6. This would be accessed by the sewer system from Coast Road.

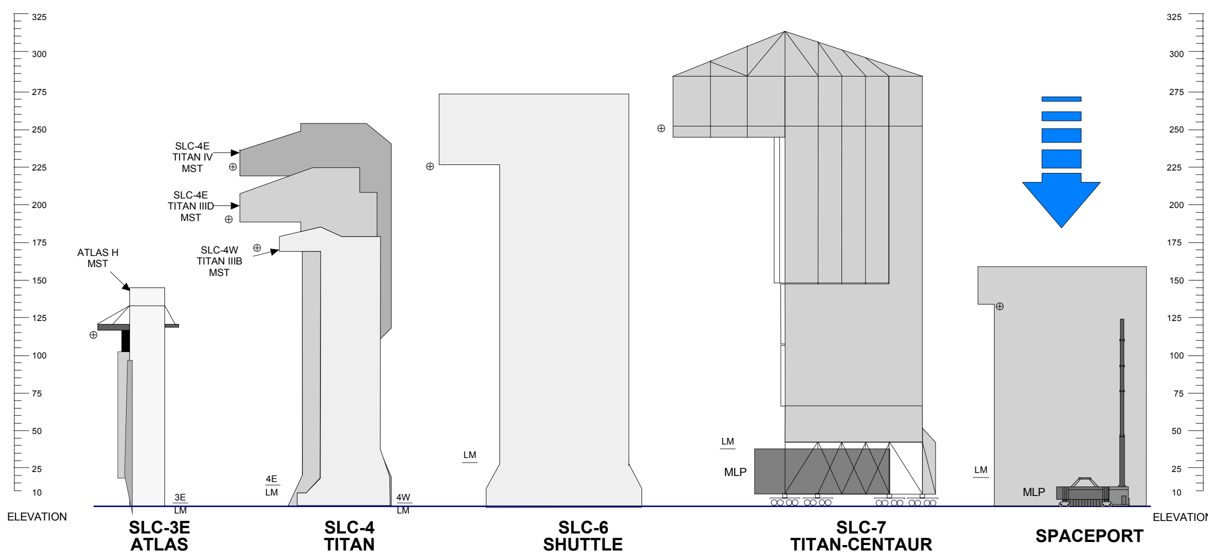



Figure 2.7. Comparison of Typical SCFs

The SCFs and the launch pads would be constructed as a single complex. Its construction limits would be approximately 91 m (300 ft) by 305 m (1000 ft). The following safety and environmental considerations were incorporated into the design and location of the SCF-launch pad complex: 1) It must remain east of Coast Road. 2) It must remain south of the wastewater treatment ponds which service SLC-6. 3) It must remain north of the 380 m (1250 ft) Q/D distance from Bldg. 330. 4) It must remain south of the OSB by 380 m (1250 ft) to satisfy the Q/D safety distance requirements. 5) It is desirable to fully utilize and replace the abandoned parking area adjacent to Coast Road to minimize the disturbance of undeveloped land.

The initial construction of the SLF would require approximately 100 people. Grading and site preparation would begin as soon as possible after the completion of the NEPA process, tentatively set for February. This would reduce direct impacts with the wildlife nesting and breeding season, which begins in mid-March and ends in mid-July. The operation and maintenance of the SLF would require up to 20 permanent employees. When users are on the launch facilities preparing and launching their vehicles, up to 50 temporary persons per SCF would be required. The temporary staff provided by the users would be expected to be on-site for 2 to 6 weeks. Parking would be provided on the pad deck at a safe distance from the processing buildings.

The construction limits of the SCF and launch pad complex would be approximately 5.3 ha (13 ac). This acreage is a conservative estimate of the total footprint of the Spaceport facilities, including roadways, rail spur access, utility and communications cable rerouting, parking lots and facility foundations. Depending upon the alternative site chosen, the actual acreage would vary. Appendix C shows a detailed breakdown of acreage for the preferred alternative site. Throughout this document the estimated acreage involved for the project will be 5.3 ha (13 ac). This would be smaller in size than either the Titan IV complex at SLC-4, the proposed Titan IV complex at SLC-7, or the Space Shuttle launch complex at SLC-6. This is indicated by the fact that the SCF-launch pad complex fits within an area the same size as one of the parking lots for SLC-6. The SLF would be used to launch rockets much smaller than a Titan or a Space Shuttle. The largest launch vehicles planned for launch from the Spaceport would be medium in size, weighing up to 227,000 kg (500,000 lbs).

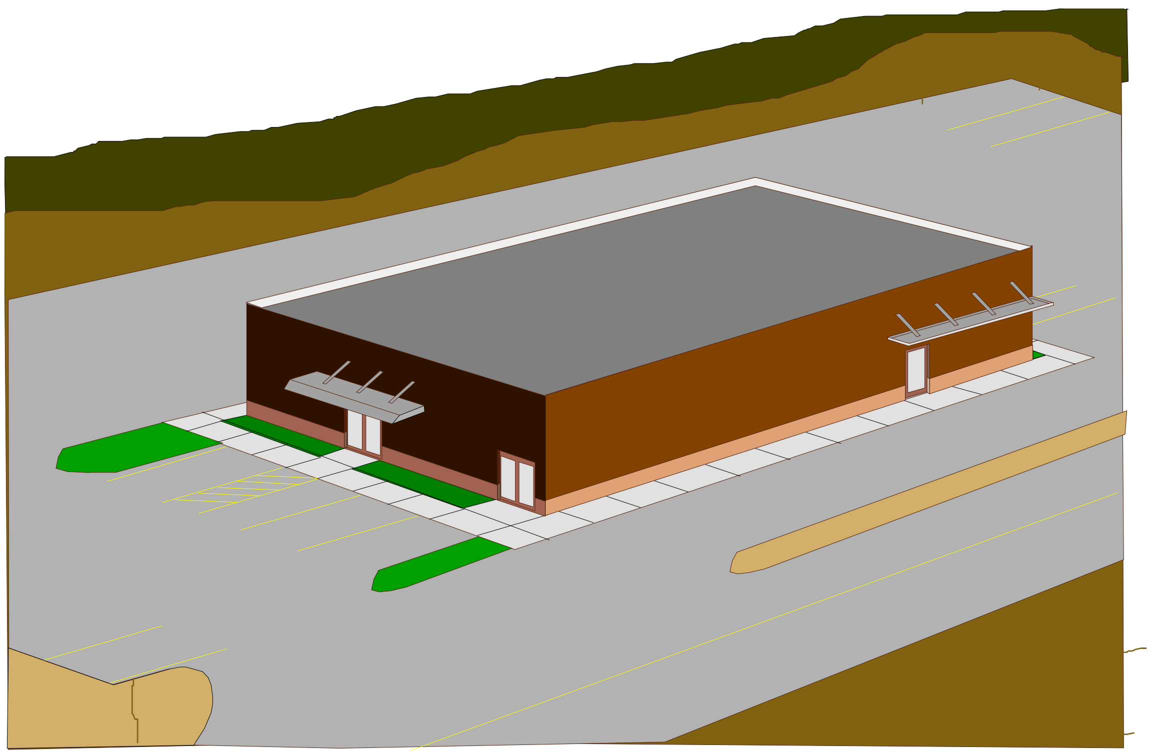


Figure 2.8. Operations Support Building

### 2.1.3 Concept of Operations

The facilities and property for the California Spaceport would be leased from the Air Force by the non-profit Western Commercial Space Center, Inc. (WCSC). WCSC, through its contractors, would provide services to all sectors of the space launch market: commercial, universities, other non-profit organizations, and the Federal government. WCSC would offer services in two major launch functions, the support of launch vehicle and payload preparation, and the provision of facilities for stacking, final checkouts and launch of a vehicle.

Overall the Spaceport currently accounts for approximately 40 new jobs in Santa Barbara County. Ultimately, 400 employment positions would be directly or indirectly created.

Services such as basic security and utilities would be provided by the Air Force to all commercial entities and contractors on Vandenberg AFB.

### 2.1.3.1 Scheduling of Operations

Facility use scheduling depends on the sequence of signed commitments and contracts and the dates required by users of the facilities. An annual user's scheduling meeting would be sponsored to establish the optimum schedule to serve the customers who desire to use all or part of the facilities and services provided through the Spaceport.

Schedules for the Integrated Processing Facility would provide for timely access into the building and delivery of shrouded payloads. Launch vehicle preparation could also be scheduled for the floor of the main hall of the IPF. As can be seen in Figure 2-3, potential congestion in the vehicle checkout facility and floor of the IPF could hinder use of the payload processing cells. An integrated schedule that merges the needs of several users would include consideration for the ingress and egress of payloads from the IPF.

Scheduling for the SLF would consider the resident time of the launch pad for each user, the launch pad configuration required for the vehicle, and potential interference with occupants of the other facilities. Launch vehicles and payloads that are prepared in the IPF would be moved to the complex with a minimum of delay. Launches from the central launch pad would be coordinated with the safety requirements and considerations of vehicles located in the SCFs. Some rocket launches would insert multiple payloads into low-earth orbit.

### 2.1.3.2 Launch Rate

The Spaceport would have the capability of conducting up to 24 missions per year when fully operational. However, this maximum potential launch rate would not be achieved until the year 2000. During Phase I of construction and operation, only one SCF would be available to customers. This would meet the needs of the Spaceport until demand for more launches would make it necessary to construct the second SCF. During this time period, the anticipated Spaceport productivity consists of 4 launches during the inaugural year of 1996, 8 in 1997, 12 in 1998, 18 in 1999, and 24 launches per year by 2000 (Figure 2.9).

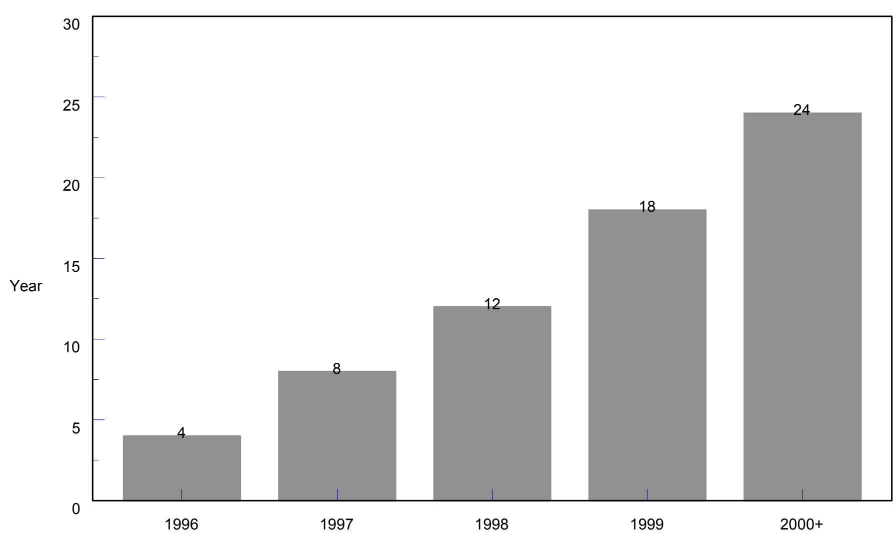



Figure 2.9. Anticipated Spaceport Launch Rates

### 2.1.3.3 Safety and Security

A full suite of safety regulations and oversight of work would be in effect at the Spaceport. The objective of the safety program of the Spaceport is to provide the best safety record in the launch industry. The users of the facilities would be responsible for the activities of their own personnel and sub-contractors. Oversight of activities would be provided by the Spaceport and, as desired, by the Air Force. Any activities not in accordance with the regulations of Vandenberg AFB and the Spaceport would be corrected by the users, and verified by Spaceport and Air Force officials.

As with all launches from Vandenberg AFB, flight safety would include monitoring of launches by the Western Range Flight Safety Officer. The 30 SW safety officials would have authority to destroy any launch vehicle that departs from the safety limits for its mission. The 30 SW safety officials would be provided a position and access to dedicated communication circuits at the Launch Control Center. At no time would launches from the Spaceport be allowed to endanger public safety.

The 30 SW Safety Officials would establish impact limit lines for each launch from the Spaceport. Impact limit lines would not extend further north than SLC-4 (R. Cortopassi, VAFB, personal communication, 1994). Areas within the impact limit lines would be evacuated prior to launch. Helicopter patrols would enforce the evacuation of the areas within the impact limit lines. Normally, a single helicopter would be used to patrol the ocean and land areas that must be cleared (Lt P. Doty, VAFB, personal communication, 1994). Helicopter altitudes would vary from 300 ft to 1,000 ft. These patrols would begin approximately three hours prior to launch and continue up to the time of the launch. No All Terrain Vehicle (ATV) patrols would be used for this purpose (MSgt Mercier, VAFB, personal communication, 1994).

WCSC would comply with the security requirements included in AFR 125-37, Air Force Resource Protection Program; AFR 207-1, Air Force Physical Security Program; and DOD 5220.22M, Industrial Security Manual as applicable to the WCSC mission or facility location. The 30th Security Police Squadron would also provide support as per the above regulations.

**2.1.3.4 Hazardous and Toxic Materials**

The handling and use of hazardous and toxic materials at the Spaceport would be limited. Solid rocket propellants would be contained in the launch vehicles themselves. These would be fueled at the factory and would arrive at VAFB as completely assembled, painted, encapsulated units.

Hazardous materials used by Spaceport customers during operations would normally consist of various solvents and cleaners, paints and primers, adhesives, alcohol, lubricants, propellants, and contaminated clothing and rags. These types of materials are typical of user requirements and would be quantified as customers identify the details of their operations in separate environmental analysis documentation. It is expected that no more than a gallon of each of the listed types of materials would be used at the Spaceport by each customer. Unused portions of the materials would be removed by the users when operations are complete.

Hazardous and toxic materials would be used on the launch complex. The primary liquid rocket motor fuels include hydrazine ($N_2H_4$), nitrogen tetroxide ($N_2O_4$), kerosene (RP-1), and liquid oxygen ($LO_2$). High pressure helium (GHe), gaseous nitrogen ($GN_2$), and other materials would also be on the complex. Fueling of the launch vehicles would be from user-supplied service trucks or carts, which would make deliveries from existing permitted facilities on Vandenberg AFB. Design, fabrication, and permitting of user-supplied carts would be the responsibility of individual Spaceport users. Fueling carts for use at the Spaceport would meet all existing Air Force, DOT, and other applicable regulatory agency requirements. There would be no permanently installed rocket fueling systems at the IPF or the SLF.

User-supplied propellant loading systems would be parked within an area that is designed to fully contain a "worst case" propellant spill. If a user desires to fuel a rocket using a mobile tanking unit, a concrete berm would be constructed to contain a spill equal to the total volume of propellant contained within the tank.

The Spaceport would provide direction on the storage, use, and disposal of hazardous materials. The wastes from operations would be handled and disposed of in accordance with Vandenberg AFB treatment, storage, and disposal permits. It is expected that no more than 10 pounds of solid hazardous waste (contaminated rags, clothing, etc.) and minimal amounts of liquid hazardous waste (waste oils, lubricants, greases, hydraulic fluid and anti-freeze) would be generated as a result of customer operations. While the Spaceport operates as a commercially leased facility, all management of hazardous waste at the Spaceport would be done in accordance with the VAFB Hazardous Waste Management Plan. This plan outlines standardized procedures for hazardous waste operations involving the identification, accumulation, labeling, storage, record keeping, transfer, disposal, and personnel protective equipment and safety training. Compliance with these procedures would be required of all Spaceport customers to effectively and legally manage any amount of hazardous waste generated. Liquid rocket fuels would be obtained through Air Force sources.

#### 2.1.3.5 Operation of the IPF

Customers would be expected to provide their own safety, hazardous materials, and security training for their personnel. WCSC would provide training materials which describe the requirements of the Air Force, WCSC, and the facility.

Launch vehicles and payloads would be brought into the IPF through the airlock or the transfer tower. Initial cleaning of transporter trailers and shipping containers would be conducted on the hardstand outside the airlock. Final cleaning and establishment of cleanroom conditions would be accomplished after the launch vehicles and payloads have entered the airlock.

WCSC would provide cleanroom furniture, personnel stands, scaffolds, and other fixtures required to support the customer's needs. Electrical power for tools and equipment would be provided by WCSC. The customers would provide their own hand tools and specialized service equipment.

Additional specialized equipment may include trailers for the transportation of payloads and launch vehicles, and specialized fueling carts for hydrazine, oxygen, nitrogen, nitrogen tetroxide, high pressure helium and kerosene. Powered aerospace ground equipment (AGE) and special purpose vehicle operations near the IPF would be limited to the minimum operating time and cycles required to support customer's requirements. Design, fabrication, and permitting of all user AGE would be the responsibility of the individual users.

#### 2.1.3.6 Operation of the SLF

Customers would be responsible for transportation of their launch vehicles and payloads to the Spaceport Launch Facility. Many of the launch vehicles and prepared payloads are expected to be moved from the IPF to the complex. Some launch vehicles and payloads could be brought to the complex from other locations on Vandenberg AFB or from outside of Vandenberg AFB. Launch vehicles and payloads may be shipped from a variety of locations depending on the point of manufacture. The points of origination, the method of transportation, and the route would vary according to current specifications. These may include air, railroad, barge or highway travel. However, since the largest rocket motor would be less than 9 feet in diameter, the use of over-sized highway transportation systems would not be required.

As agreed during the scheduling meetings, the customer would be assigned a Stack and Checkout Facility (SCF) sufficiently equipped to support final preparation and launch of the vehicle and payload. The SCF would provide access to the launch vehicles and payloads. Stacking operations in the SCF would be conducted by the customers. WCSC staff would ensure access to the pads, provide electrical utilities including general lighting, operate the mobile launch platform, and provide security. Customers would likely remain on the complex for no more than two to three weeks per mission.

WCSC would provide operations support and administrative space within the OSB. Customers would be able to obtain secured space on a short-term basis prior to vehicle arrival on the complex, until after launch. The support from WCSC would be limited to space, basic office furniture, utilities, and basic building security. Highbay space is available within the SCF to support general customer operations like limited payload processing and equipment maintenance.

#### 2.1.3.7 Launch Azimuths

Launch azimuths would be available from headings of 168$^{o}$ from true north to 220$^{o}$ from true north. Figure 2.10 illustrates the launch tracks available to potential users of the Spaceport.

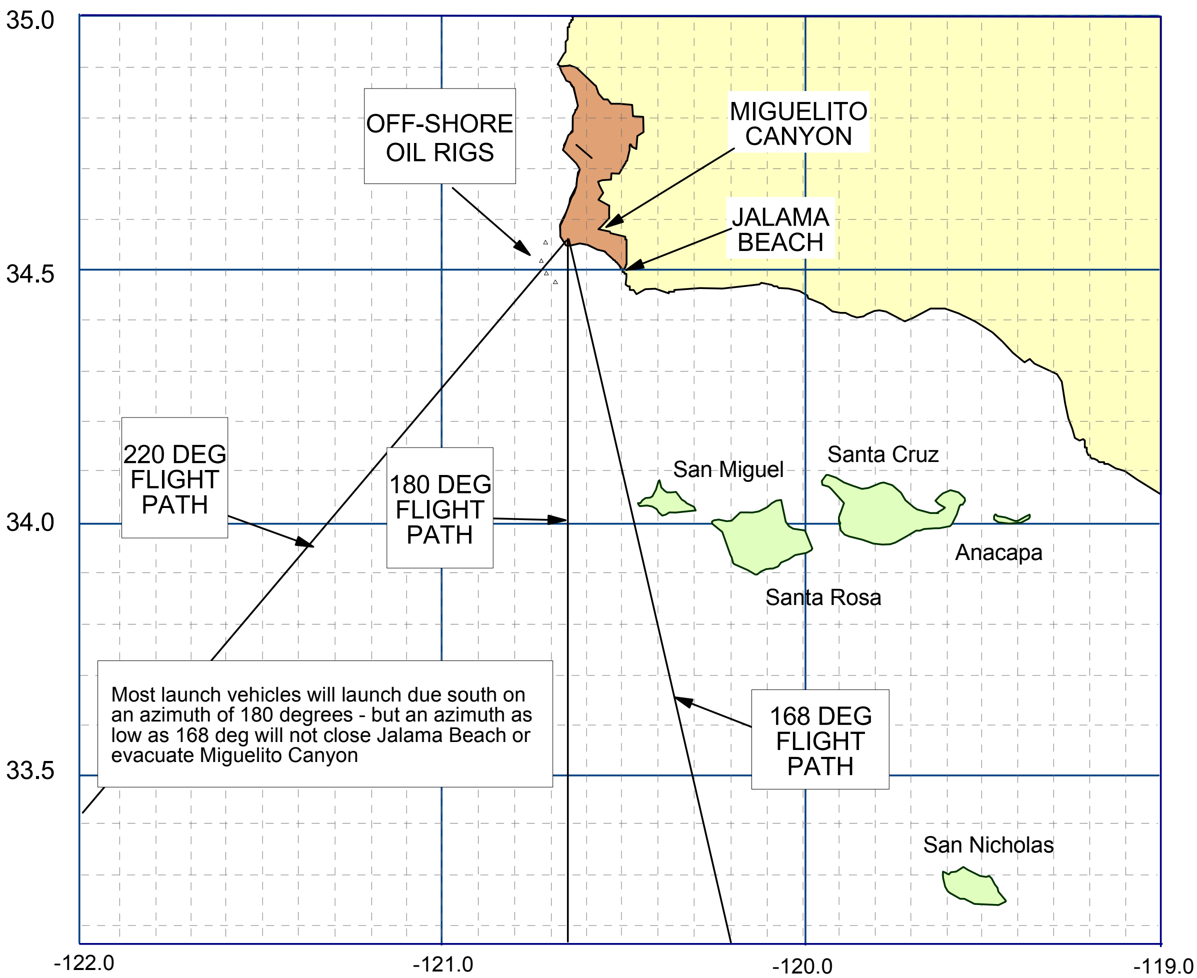



Figure 2.10. Range of Launch Azimuths

The basis for the launch azimuths are prescribed by agreement between the Air Force (30 SW/SEY) and WCSC. This agreement is based on Air Force analyses of hazards and risks to nearby populations and recreational areas. The resulting limits to launch azimuths, 168$^{o}$ and 220$^{o}$, are based on the impact limit lines, identified during the risk analyses. These boundaries are considered maxima. Recreational areas to the south of Vandenberg AFB would not be affected by launches from the Spaceport. Of all existing launch sites on Vandenberg, the proposed site for the Spaceport would have the least potential for causing closures of public beach areas. This is due to the geographic location of the proposed Spaceport site to the south and west of all existing Air Force launch sites.

Another factor that decreases the likelihood of beach closures is the flexible nature of the proposed launch vehicles. Typically, beach closures would be caused by performance limitations of the launch vehicle. The new, modern launch vehicles that would utilize Spaceport facilities are modular in design, allowing more or less performance capability to be applied, depending on mission requirements. The modularity feature of the new launch vehicles is very important in making the commercial space industry efficient and profitable, but a benefit of this feature would be that performance limitations would not drive closures of public recreation areas.

### 2.1.4 Construction Schedule

All of the facilities would be developed in a sequence that provides for the quickest and least expensive development program. The Spaceport would be constructed in phases, as shown in Figure 2.11. Phase I of the project would build the launch duct, a single SCF, the OSB, the access road and the railroad spur. Modification of the IPF would also be done during Phase I. Phase II construction would build the second SCF and would only begin when market projections identify a requirement. Completion of the first phase of the development program is proposed for the summer of 1996.

Work packages would be used to manage the development program. The IPF package supports the activation of the Integrated Processing Facility and configuration and installation of the Launch Control Center. Included in the work at the IPF would be the upgrade to the communications systems within the IPF and extension of the communications to an interface near the road to the launch complex. The interior work for the IPF would be preparation for launches. The IPF should be ready to support the preparation of launch vehicles and payloads by July, 1995.

The SLF package includes the development of two SCFs, a central launch pad, and a 6,000 sq ft OSB. Fences, security systems, utilities, and roads would be included in this package. The complex development would be completed as soon as possible after all permits are obtained. The goal is to support a first launch from the Spaceport by September, 1996.

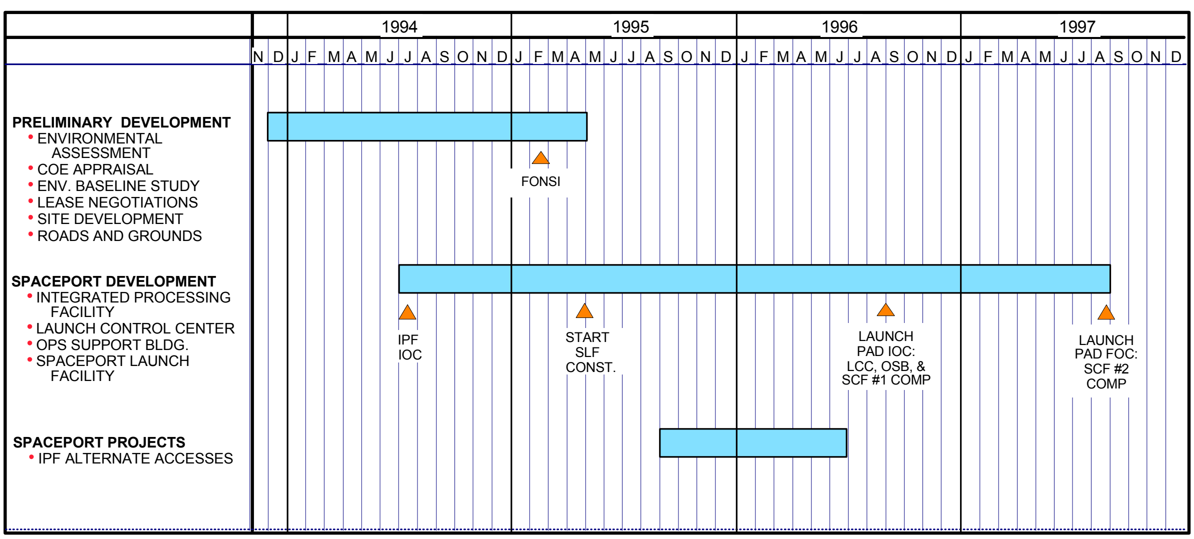



Figure 2.11. Spaceport Development and Construction Schedule

### 2.1.5 Launch Vehicle Descriptions

The Spaceport would be capable of supporting multiple booster configurations. These vehicles would not require the use of sound suppression deluge water. Each of these vehicles is shown in Figure 2.12 and described in this section. The Titan IV, Atlas II, Delta II, and Pegasus launch vehicles (shown in Figure 2.12) are pictured for comparison purposes only, and are not planned for launch from the Spaceport. Property descriptions of the proposed launch vehicles are summarized in Table 2-1, which includes the first stage exhaust products.

Table 2-1. Typical Spaceport Launch Vehicles

| Vehicle | Propellant Type | First Stage Propellant Weight[1] | Thrust[1] | Principal Exhaust Products |
|---|---|---|---|---|
| Aquila | Hybrid | 62,000 | 250,000 | CO, $CO_2$, $H_2$, |
| Orbex | Solid | 28,600 | 135,000 | HCl, $AL_2O_3$, CO |
| LLV | Solid | 108,000 | 366,600 | HCl, $AL_2O_3$, CO |
| Minuteman | Solid | 45,900 | 206,100 | HCl, $AL_2O_3$, CO |
| Taurus | Solid | 108,000 | 366,600 | HCl, $AL_2O_3$, CO |
| PA-2 | Liquid | 13,450 | 110,000 | $H_2O$, $CO_2$ |
| Conestoga | Solid | 88,000 | 355,600 | HCl, $AL_2O_3$, CO |
| Eagle | Solid | 104,700 | 500,000 | HCl, $AL_2O_3$, CO |

[1]Units are in pounds.

Each vehicle would be equipped with on-board sensors to measure vehicle inflight performance and transmit the information to ground receivers, in accordance with Inter Range Instrumentation Group (IRIG) standards (USAF 1993c). The data would be used to evaluate the conformity of the launch with safety requirements and provide for post-flight analyses. In addition, each vehicle would be equipped with onboard radio receivers and ordnance equipment, as required by the Air Force for destruction of the vehicle if its flight is deemed erratic.

The Spaceport design accommodates the needs of multiple launch vehicle providers. In the past, each user was forced to build new launch facilities, or modify existing facilities, in order to meet launch requirements. If each user was to build ideal facilities, and provide operations and maintenance personnel to support them, American launch providers would not be able to compete with efficient, cost-effective, foreign competitors. Modifying existing, abandoned or active Air Force launch sites for commercial launches would not be economically feasible for individual users. The cost of modifying existing facilities is often as high, or higher, than building new facilities due to demolition costs of old infrastructure. If an active Air Force site is modified, it must be returned to its original configuration after the mission is complete, further increasing per mission costs. The Spaceport concept allows long-term maintenance costs to be spread among multiple users, thereby reducing the financial load on any single user. Environmental impacts are reduced because redundant facilities would not be created to support multiple users. The Spaceport would be able to accommodate the majority of commercial requirements.

The following sections describe potential launch vehicles that could be launched from the Spaceport. Since the launch manifest and mission model for Spaceport usage is in the formative stage, environmental analyses contained within this document assume a worst-case scenario of 24 launches per year of the largest launch vehicle proposed, the Lockheed Launch Vehicle (LLV-3). This approach ensures all potential environmental impacts are addressed within the document.

### 2.1.5.1 Aquila

The Aquila (American Rocket Corporation) family of launch vehicles is based on the H-1800 motor. The Aquila 1, 21 and 31 are being considered for launch from the Spaceport. This rocket motor is powered by a hybrid fuel consisting of liquid oxygen ($LO_2$) and hydroxyl terminated polybutadiene (HTPB). It produces 250,000 pounds of thrust from a total fuel weight of approximately 62,000 pounds. Exhaust products include carbon monoxide, carbon dioxide, hydrogen, water, and traces of nitrogen and hydroxyl groups. The Aquila has the least potential for environmental impacts of all the launch systems considered for service by the Spaceport, because it generates no hydrogen chloride as an exhaust. This is a product of its unique propulsion system, which uses liquid oxygen to burn an inert, rubber-like HTPB fuel. A full environmental assessment was completed that described the impacts of this type of vehicle for launches from North VAFB in July of 1989, resulting in a Finding of No Significant Impact (USAF 1989b).

#### 2.1.5.2 Orbex

The Orbex family of vehicles (CTA Launch Services) is solid fueled with ammonium perchlorate/aluminum powder. They consist of four stages; the first stage is a Castor IV B-XL (Thiokol), the second and third stages are Orbus 7S motors (United Technologies Corp), and the fourth stage is the Star 30E (Thiokol). The baseline model, the Orbex 7E, weighs approximately 42,000 pounds. The first stage exhaust products include hydrogen chloride, aluminum oxide, carbon monoxide, and nitric oxide. This vehicle is currently in the design phase with no plans for production until customer interest and investment is available.

#### 2.1.5.3 Lockheed Launch Vehicle

The Lockheed Launch Vehicle (Lockheed Missiles and Space Company) is based on a rocket motor fueled by solid propellants, the Castor 120™ (Thiokol Corporation). This rocket motor contains approximately 49,000 kg (108,000 lb) of solid ammonium perchlorate/aluminum powder in a hydroxyl terminated polybutadiene (HTPB) solid fuel. The rocket burns approximately 621 kg (1,367 lb) of fuel per second and produces approximately 366,000 pounds of thrust. The major exhaust products are hydrogen chloride, aluminum oxide particles, carbon monoxide and nitric oxide. The LLV also includes an upper stage, the Orbus 21D (United Technology Corporation, Chemical Systems Division) which is also a solid rocket motor using the same type of solid fuel.

The LLV is available in three variants; the LLV 1, the LLV 2 and the LLV 3. The LLV 1 has a single main booster. The LLV 2 has two stages, both of which are the Castor 120™. An LLV 3 core is an LLV 2 with the addition of up to six Castor IVA™ or Castor IVXL™ (Thiokol Corporation) rocket motors strapped to the first stage. The strap-on rocket motors fire simultaneously with the main first stage motor. The LLV 3 is the largest vehicle planned to be launched from the Spaceport Launch Facility. It is approximately 30 m (100 ft) tall and weighs up to 194,154 kg (428,036 lb). The payload capacities of the LLV 1 and the LLV 2 are 1063 kg (2343 lb) and 2413 kg (5320 lb), respectively. The LLV 3 can boost payloads from 3043 kg (6710 lb) to 4073 kg (8980 lb), depending on the number of strap-on motors employed.

#### 2.1.5.4 Minuteman II

The Minuteman II (Martin Marietta, under contract to the USAF) first and second stages use a solid propellant rocket motor. The fuel for the first and second stage is approximately 70% ammonium perchlorate, 16% aluminum, and 14% binder (either epoxy or polybutadiene). The upper stage may be an Orbus 7. The exhaust products of the first stage are hydrogen chloride, aluminum oxide particles, carbon monoxide, and nitric oxide.

Figure 2.12. Representative Launch Vehicles

#### 2.1.5.5 Taurus

The Taurus (Orbital Sciences Corporation) is a four-stage inertially-guided launch vehicle with a 0/1 interstage (Engineering Science 1992). The first stage of the Taurus is a Castor 120™ with a Pegasus (Orbital Sciences Corporation) providing three additional stages of boost. The Pegasus is a three-stage solid rocket booster with a total weight of approximately 16,000 kg (35,000 lb). The overall length of the Taurus is 27.0 m (88.5 ft) and its gross lift-off weight is 71,078 kg (156,700 lb). It is designed to service small payloads in the range of 454 kg (1,000 lb) to 1361 kg (3,000 lb). As for other previously discussed rockets which use the Castor 120™, the first stage exhaust products are hydrogen chloride, aluminum oxide, carbon monoxide, and oxides of nitrogen. The Taurus has been successfully launched from North Vandenberg AFB.

#### 2.1.5.6 PA-2

The PA-2 (PacAstro Corporation) is a two-stage launch vehicle fueled by 2.5:1 mixture of liquid oxygen ($LO_2$) and kerosene (RP-1). The first stage total fuel load is 24,000 kg (53,000 lb), and the second stage fuel capacity is 6100 kg (13,450 lb). Both stages are pressurized by gaseous helium. The exhaust products, $H_2O$ and $CO_2$, are typical of hydrocarbon fuel combustion. The PA-2 can lift payloads up to 225 kg (500 lb) into polar orbit. This vehicle is in the preliminary concept phase with no schedules for final design and production.

The PA-2 design is based on operational liquid fuel rockets which have been flown for over 30 years with high reliability. The liquid propellant system allows for engine ignition and test prior to launch. This reduces the risk of failure at launch ignition. This also avoids catastrophic failure by allowing missions to be safely aborted by shutting off the engines.

#### 2.1.5.7 Conestoga

The Conestoga (EER Systems) is a family of solid rocket launch vehicles which employs the Castor IVA™ solid fueled rocket motor. The solid fuel is an HTPB inhibited ammonium perchlorate and aluminum powder. The major exhaust products are hydrogen chloride, aluminum oxide particles, carbon monoxide, and nitrous oxide.

#### 2.1.5.8 Eagle S-Series

The Eagle (E'Prime Aerospace Corporation) is a family of solid fueled launch vehicles based on the Peacekeeper (USAF) missile rocket motors. The upper stage, or the post boost vehicle, is liquid fueled. The Eagle S-I weighs 71,700 kg (158,000 lb) and can boost 1361 kg (3,300 lb) into polar orbit. The larger Eagle S-II weighs 119,000 kg (263,000 lb) and can insert 2,500 kg (5,500 lb) into polar orbit.

The Peacekeeper has a 100 percent safety record in 26 flights, as of 1991. Its payload capacity ranges from 1361 kg (3,000 lb) to 4536 kg (10,000 lb).

The Eagle first stage uses the HTPB inhibited ammonium perchlorate and aluminum powder fuel. The major exhaust products are hydrogen chloride, aluminum oxide particles, carbon monoxide, and nitrous oxide.

### 2.2 Alternatives to the Proposed Action

The potential alternatives available to the Air Force include: 1) a decision to provide another location on Vandenberg AFB which meets constraints of access to launch tracks required by WCSC customers, 2) utilize excess facilities at another Air Force base, or, 3) the no-action alternative.

The creation of the California Spaceport has similarities and differences to Government programs. The major similarity is that the Spaceport would provide facilities for launches of vehicles to space for a variety of commercial purposes. The major difference of the proposed action from Air Force programs is that the Spaceport would be primarily commercially funded and secondarily funded by the Federal Government.

Development of the Spaceport would be underwritten by industry and a grant from the Department of Defense. The Federal grant from the Air Force was awarded for the specific technical and business proposal which described the Spaceport, the use of the existing SLC-6 Payload Preparation Room, and available land on South Vandenberg AFB. Because of this constraint, the Air Force's total available excess assets for support of space launch activities are not acceptable as alternatives to the proposed action.

### 2.2.1 The No-Action Alternative

Selection of the No-Action Alternative results in the Government not granting a lease for the use of the Integrated Processing Facility and lease of the land for development of the Spaceport Launch Facility, or DOT not granting a license. Also included in this decision is the overt action by the Government to not provide other facilities at other locations that meet the required operational capability needed by WCSC to function as a provider of processing and launch facilities for universities, commercial ventures, and the Government.

This alternative would mean that the California Spaceport would not be built at Vandenberg, which is the only US launch facility capable of launching spacecraft into polar orbit. The No-Action alternative would result in the loss of Federal grant funds, industry matching funds, and commercial investment in the Spaceport project and other sectors of the local economy. Approximately 40 jobs presently supported by efforts to build the Spaceport at Vandenberg AFB would be lost immediately, and up to 400 projected commercial space related jobs would not come to the Central Coast. The No-Action alternative would also have a severe economic impact upon the Western Commercial Space Center and its contractors.

The No-Action alternative would result in the fewest environmental impacts. There would be no cultural, biological, atmospheric, land, or water resources disturbed if this alternative is selected. The communities surrounding Vandenberg AFB would also not obtain the benefits of the addition of the predicted highly technical jobs that would be created by Spaceport programs.

Government satellite and booster programs without the funding to support dedicated facilities would not have the opportunity to take advantage of commercially available Spaceport services if the No-Action alternative is chosen. Each program would be forced to temporarily acquire, renovate, and modify a facility for short-term use, adding a substantial burden to already tight budgets. This approach is wasteful of government resources and causes more environmental impacts than a single, well-maintained commercial facility.

This alternative would reduce competitive status of US launch services companies who require commercially-available, reliable, state-of-the-art launch facilities and Range infrastructure at reasonable cost in order to compete with foreign launch providers. Commercial launch services providers would be forced to license vacant government facilities that are temporarily excess to government needs. If a government requirement for a licensed facility is identified, commercial investment in the facility would be lost, and pending launch contracts could not be completed. Presently there are no dedicated facilities to support commercial companies desiring to launch payloads into polar orbit in the United States. Without these dedicated facilities, commercial users would not be able to convince customers that the facilities would be available when needed. Commercial launch providers would be forced to look elsewhere, perhaps to foreign companies or governments, for reliable launch facilities.

### 2.2.2 Alternative Sites Eliminated From Further Consideration

#### 2.2.2.1 Outside California

There are several potential alternatives to the proposed action which would utilize sites outside California. However, these alternatives are not feasible for WCSC. As discussed below, these sites would not be suitable with respect to one or more criteria. Additionally, since the federal funding for WCSC is premised on the development of a commercial spaceport at Vandenberg AFB, the pursuit of outside alternatives would require the reinitiation of the granting process.

Two potential sites outside of the State of California include launch facilities at Kennedy Space Center and Cape Canaveral, both in Florida. The potential customers who desire to use the Spaceport require launches on azimuths from 168$^{o}$ true North to 220$^{o}$ from true north. Direct launches toward these azimuths are not allowed from Kennedy Space Center and Cape Canaveral Air Force Station because this would involve unacceptable safety risks associated with the over-flight of populated areas. Therefore, these two alternatives are not feasible for development of the Spaceport.

A third alternative is a potential commercially developed launch site in Alaska. However, this site is currently in an undeveloped condition. Moreover, the Alaska alternative would have to contend with adverse weather as well as a lack of instrumentation for early tracking and control of launch vehicles. Therefore, this alternative is not feasible for development of the Spaceport.

Sites might be available outside the United States where launches to the south over ocean or vacant land are possible. Arianespace launches its polar orbit flights from French Guiana. There are spaceports in Russia, China, and India. However, none of these locations are excess US Air Force facilities. Therefore, potential excess launch facilities outside of the United States are not feasible for WCSC.

**2.2.2.2 Alternative Sites at Vandenberg AFB**

The major precept of the Commercial Space Launch Act is that the Secretary of Transportation is directed to facilitate and encourage the acquisition by the private sector and State governments of--launch property of the United States Government that is excess or otherwise is not needed for public use. Within Vandenberg AFB, several potential sites meet this criterion. These will be discussed in order of their geographic distribution, from north to south. Most of these facilities and sites have been rejected as infeasible. Some launch facilities on South Vandenberg are feasible and will be analyzed in this environmental assessment as alternatives to the launch facilities described in the proposed action.

**2.2.2.2.1 North Vandenberg**

Excess launch facilities are potentially available on North Vandenberg AFB. However, the specifications of Spaceport customers include access to circumpolar orbits. To accomplish this from North VAFB would require a "dogleg" maneuver during the early phases of the launch trajectory. A "dogleg" maneuver means that in order to avoid the over-flight of populated areas, a rocket must be launched in a southwesterly direction, then turned to the south to obtain a polar orbit. This inflight adjustment would require an increase in booster power relative to the potential maximum size of the payload. A launch towards the west requires more energy than a launch towards the south. This energy loss translates directly into reduced payload weight. This would have serious consequences to the economic viability of the Spaceport. Therefore, excess launch facilities on North VAFB are not feasible as alternatives for the development of the Spaceport and will not be analyzed as part of this environmental assessment.

**2.2.2.2.2 South Vandenberg**

Space Launch Complex 3 (SLC-3), on South Vandenberg AFB, was considered as a potential alternative for the development of the Spaceport. Launches from SLC-3E to the south are possible but would over-fly the unique national assets at SLC-4E and SLC-4W. SLC-3E is dedicated to the launch of Atlas launch vehicles which support national defense programs. SLC-3W is too small to accommodate the expected launch rates from the Spaceport. In addition, commercial launch teams would not desire to impact operations at the expensive Government assets at SLC-4 by causing frequent evacuations for commercial launches. Sharing of SLC-3 with the Government would not allow assurance that private investment in SLC-3 would be profitable if the Government wanted all of SLC-3 returned to its control part or all of the time. Therefore, SLC-3 is not a feasible alternative for the development of the Spaceport and will not be analyzed as part of this environmental assessment.

The two Titan launch pads on South Vandenberg AFB, SLC-4E and SLC-4W, are in active use for Titan launches, which are planned through the 1990s. They are used for national programs, including defense. These are unique national assets, and they cannot be encumbered by programs outside of those designated for launch from SLC-4E and SLC-4W. The two SLCs are not available for commercial launch activities. Therefore, SLC-4 is not a feasible alternative for the development of the Spaceport and will not be analyzed as part of this environmental assessment.

Space Launch Complex 5 (SLC-5) was considered as a potential location of the Spaceport. Polar launches are possible from SLC-5. When WCSC and the Air Force initiated discussions for the development of the Spaceport, SLC-5 was already the subject of discussions with another commercial firm. As such, SLC-5 was not immediately available to WCSC as a launch pad. Subsequently, the commercial firm interested in operating SLC-5 decided not to pursue plans for operations at Vandenberg. Discussions concerning SLC-5 were reinitiated between the Air Force and WCSC. After several visits to the site, it was concluded that the complex would require extensive modification before it could be useful as a site for the Spaceport since SLC-5 does not have a launch duct. A new launch duct would have to vent to the south, directly into the biologically sensitive Honda Creek area, an unnecessary risk to threatened and endangered species known to exist there. The proximity of the site to the sensitive Honda Canyon area makes it highly undesirable for heavy construction and increased launch operations. SLC-5 is also too small for the launch complex development required for the Spaceport's expected launch rates. Steep topographical contours for the site are oriented in an east-west direction, requiring massive cut and fill operations to accommodate the present design of the Spaceport. The Spaceport would occupy approximately 11.4 acres, whereas SLC-5 provides less than 5 acres of usable space. Therefore, SLC-5 is not a feasible alternative for development of the Spaceport and will not be analyzed as part of this environmental assessment.

SLC-6 is another potential alternate launch site. This launch facility is adjacent to the IPF. However, like SLC-5, SLC-6 is the subject of discussions for license to another commercial firm. At this time, SLC-6 is not available to perform modifications on the scale required to make the site operationally and economically viable for the majority of commercial users. This complex has a vast amount of Space Shuttle infrastructure that would have to be removed before the Spaceport facilities can be built. The cost and schedule involved with clearing the Shuttle facilities would be prohibitive for a small commercial enterprise. SLC-6 represents a substantial investment of taxpayer money and the Air Force is unlikely to relinquish control of the site on a lease basis. A lease would be required to protect the significant commercial investment of capital. Long-term and continuous use of SLC-6 by WCSC is not expected to be possible under current lease and negotiation positions. Therefore, SLC-6 is not feasible for development of the Spaceport and will not be analyzed as part of this environmental assessment.

The parking lot area on the north side of SLC-6 and adjacent to the IPF was considered as an alternative site for development of the Spaceport. This site is considered undesirable because of its close proximity to SLC-6, and the Titan IV solid rocket motor processing and storage facilities located in a nearby building (Bldg. 398). Because of safety restrictions, these facilities would have to be evacuated during every launch at the Spaceport, causing delays to Air Force schedules and priorities. Because of the extremely close proximity of this site to SLC-6, building the Spaceport in the North Parking Lot means that the Air Force would be precluded from using SLC-6 for a future development of a new heavy lift vehicle. Therefore, the north parking lot area at SLC-6 is not a feasible alternative for the development of the Spaceport and will not be analyzed as part of this environmental assessment.

### 2.2.3 Feasible Alternatives Considered

An undeveloped plot of land to the north of SLC-5 was considered for development of the Spaceport Launch Facility (SLF). This is located on the Old Surf Road, immediately north of Delphy Road. Construction of the SLF at this site would involve balanced cut and fill operations over approximately 20 acres. Utilities would be routed to the site from Building 748 (Hut 11) about 1.5 miles north of SLC-5, east to Old Surf Road, and then south along Old Surf Road to the new launch facility. The existing Building 596 would be remodeled to provide operations support. This alternative is considered feasible for development of the Spaceport and will be analyzed as the "SLC-5 North" alternative.

An undeveloped site on the southerly slopes of Cypress Ridge was also considered for development of the SLF. This site is 3.0 km (1.9 mi) to the south of SLC-6. It was previously considered as a launch site for the Titan IV/Centaur (USAF 1989a). Although the SLF would be smaller than the previously proposed Titan launch complex, much of the environmental analyses and conclusions for the Titan IV/Centaur are applicable to the current environmental assessment.

At the Cypress Ridge site, the SLF would be located on the south-facing slope, along the 400 ft contour. This would consist of the launch pad, the SCFs, OSB, utilities, and an access road. The paved access road of 305 m (1,000 ft) in length would connect the launch facility to the Coast Road, immediately to the west. The SCFs, the OSB and the launch pad would be similar to those proposed under the preferred alternative. However, there is no railroad access to this area. This potential launch facility is considered feasible and will be analyzed as the "Cypress Ridge" alternative.

## 3.0 THE EXISTING ENVIRONMENT

This discussion of the existing environment is limited to those resources, or related resources, that could be affected by the implementation of the California Spaceport at Vandenberg Air Force Base (VAFB). Development of the Spaceport would include: 1) the adaptation of the Payload Preparation Room at Space Launch Complex Six for use as an Integrated Processing Facility, and 2) the construction of the Spaceport Launch Facility immediately to the south of SLC-6. The completed Spaceport would be used to prepare and launch payloads into low earth orbit.

Sources of potential impacts to the environment from the construction and operation of the Spaceport include construction activities, the use of hazardous materials, creation of exhaust plumes, emission of air pollutants, rocket motor noises, sonic booms, and habitat loss. The scope and the geographic extent of the environmental discussions in this section will vary between resources, as prescribed by these potential effects. The environmental consequences of the Spaceport are discussed in Section 4.

### 3.1 Geographic Location

Vandenberg AFB is located in Santa Barbara County, on the west coast of south central California. The nearest major metropolitan areas include San Francisco, 442 km (275 mi) to the north; Los Angeles, 236 km (147 mi) to the southeast; and Santa Barbara, 97 km (60 mi) to the southeast. Santa Maria, 10 km (16 mi) to the northeast of VAFB, and Lompoc, immediately to the east, are the nearest cities. VAFB has a land area of 39,822 ha (98,400 ac) and is bounded on the west by 56 km (35 mi) of Pacific Ocean coastline.

Vandenberg AFB is administratively divided into North Vandenberg and South Vandenberg (Figure 3-1). The proposed action would be implemented on South Vandenberg at the Integrated Processing Facility and the Spaceport Launch Facility. The IPF is an existing building which is located at SLC-6. The primary components of the SLF, the launch mount and the Stack and Checkout Facilities, would be located 0.61 km (0.38 mi) to the southwest of the IPF. An Operations Support Building would also be constructed as part of the SLF. The SLF polygon in Figure 3.1 is the leased acreage; the actual construction footprint will be much smaller. Together, the SLF and IPF constitute the Spaceport.

The Spaceport is approximately 21 km (13 mi) to the southwest of Lompoc, California. Although the Spaceport is within 1.6 km (1.0 mi) of the Pacific coast, it is physically separated from Lompoc and other populated areas by the western extremities of the Santa Ynez Mountains. Automobile and truck services from North Vandenberg are provided as far south as the Boathouse Flats via the Coast Road. In addition, railroad tracks, maintained by the Southern Pacific Railroad, pass between Coast Road and the coastline.

### 3.2 Cultural Resources

#### 3.2.1 Prehistory

The prehistory of VAFB, which is considered part of the south central coast region of California, is uncommonly rich, spanning at least 9000 years. The following summary draws largely from Erlandson (1993:64-71), which synthesizes current research in the area. The prehistory of the central coast region can be divided into four broad periods based on changes in economy and technology, social organization, and population size (Rogers 1929, Wallace 1955, Warren 1968, King 1990). While claims have been made for earlier occupation of the area, the earliest well-documented remains are associated with Paleoindian peoples (12,000 to 9,000 years ago).

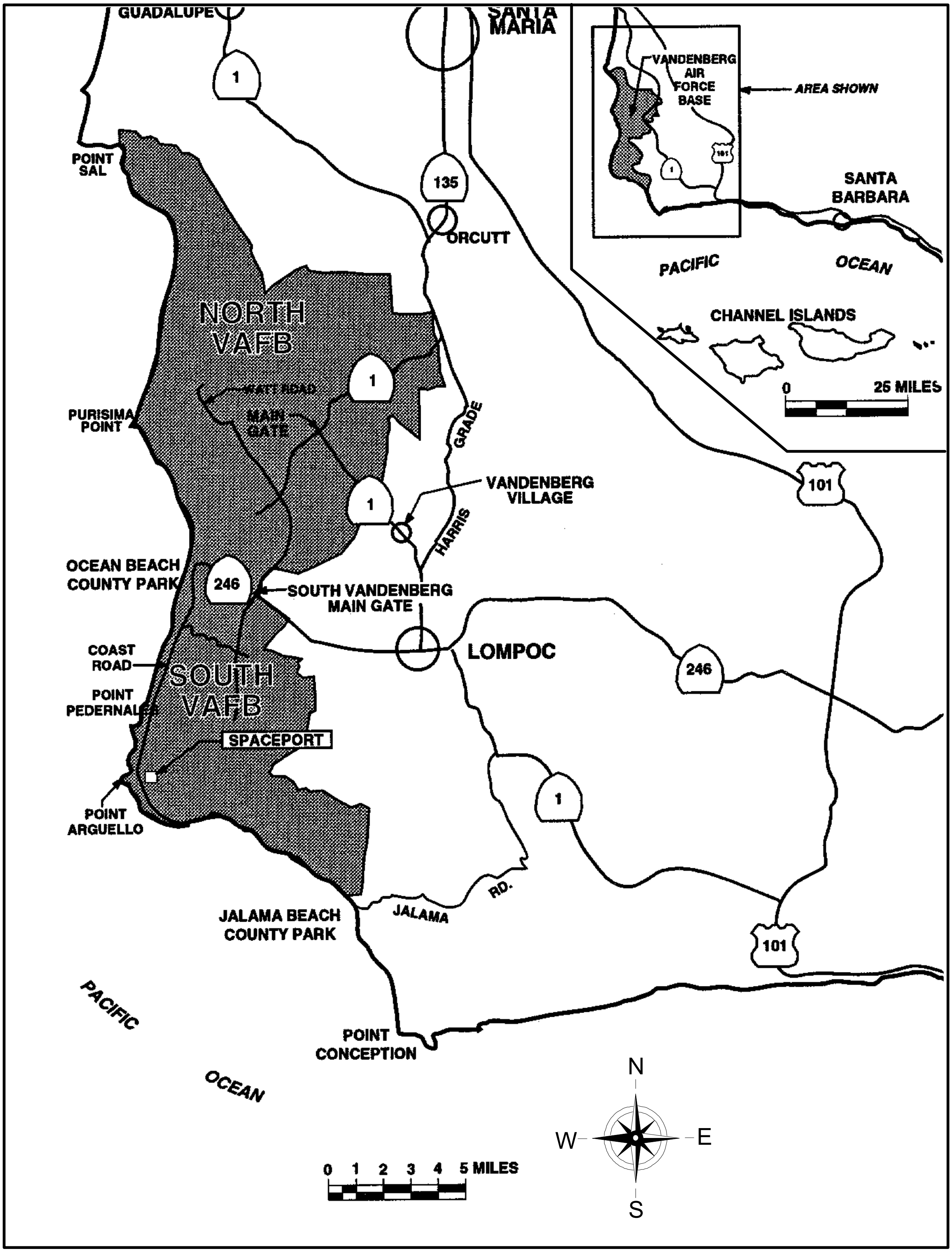



Figure 3.1. North and South Vandenberg Air Force Base

Paleoindian sites in coastal California are characterized by the presence of chipped stone tools and a lack of the millingstones common in later periods. One of these rare Paleo-Coastal sites is a fluted projectile point fragment. It was found on a coastal plain east of Point Conception approximately 12.9 km (8.0 mi) south of the proposed Spaceport. Site SBA-931, located at the mouth of the Santa Ynez River north of Point Conception, also appears to have been occupied about 9,000 years ago (Erlandson et al. 1987, Glassow 1991).

Sites of the later periods are more common, probably reflecting both better preservation and increasing population size. In Millingstone sites (9,000 to 5,000 years ago), grinding stones for processing seeds and other plants are relatively more common than projectile points and other formal chipped stone tools. This period saw reliance more on gathered resources, such as seeds and shellfish, than on fishing and hunting, and the society was probably egalitarian.

Mortars and pestles (probably for processing acorns), projectile points, and diverse land- and sea-animal remains become prevalent in sites of 5,500 to 2,500 years ago. These hunting peoples intensified and expanded upon earlier subsistence strategies, and sites show increases through time in population size, density, and settlement diversity.

About 2,500 years ago, sites began gradually to reflect the "sophisticated and fully maritime culture" of the coastal Chumash or Canaliño (2,500 to 200 years ago) (Erlandson 1993). The Chumash of this period were characterized by well-organized towns of up to 1,000, hierarchical social organization, occupational specialization, a money economy and extensive trade, the use of plank boats (south of Point Conception), and a proliferation of material goods of all kinds.

### 3.2.2 Ethnohistory

The Chumash living in the VAFB area have been grouped with the Purisimeño Chumash (King 1984, Greenwood 1978), whose range along the coast was from Point Conception to the Santa Maria River Area (Osland 1993). Their material culture, social organization, traditions and rituals, and cosmology are described in Blackburn (1975), Johnson (1988), Hudson et al. (1977), and Hudson and Underhay (1978).

The era of Chumash contact with Europeans began with initial Spanish exploration in 1542 (Landberg 1965). In 1769 the Portolá expedition, traveling overland from San Diego to Monterey, stopped at *Nocto* (King 1984:I-23). This was a Chumash village of 60 to 70 people, located about two miles east of Cypress Ridge. Juan Bautista de Anza and his 240 companions camped in the vicinity of *Nocto* on their 1775-6 trip from Mexico to San Francisco. The next closest ethnohistoric village to the north was *Lompoc*, near the Santa Ynez River about three miles inland. *Silimastus* was located on the Santa Barbara Channel to the south, at Jalama.

The Mission of San Luis Obispo, founded in 1772, was the first Spanish establishment in Chumash Territory (King 1984). This was followed by the Mission la Purisíma Conceptíon in 1788, located in the present-day city of Lompoc. By 1803 La Purisima had removed the Chumash from *Nocto*, and by the time of Mission secularization in 1834 missionization and disease had virtually eliminated the Chumash and their culture (Greenwood 1978).

### 3.2.3 History

The project area became Mission lands after the last of the people of *Nocto* and its neighboring villages were recruited to La Purisima in 1803. After Mission lands were secularized, the project area was within the northern part of the Rancho Punta de la Conceptíon, called Rancho Espada. Rancho Espada became part of the Dibblee-Hollister holdings during the 1870s. In 1879, Robert Sudden began building a wharf near Point Arguello. He bought the Rancho Espada from W.W. Hollister in 1882, and moved the wharf 5 km (3 mi) south. Various Suddens managed the ranch, which was used mostly for cattle and horse grazing, until it was acquired by the US Air Force in 1966 (Environmental Solutions 1990a). Oil exploration began in the project area in the early 1920s.

North Vandenberg AFB began as Camp Cooke, an Army tank and artillery training area, in 1941 (Engineering Science 1992). The SLC-3 and SLC-4 portions of South Vandenberg AFB were originally managed by the US Navy. In 1957, the Air Force acquired Camp Cooke, which became Vandenberg Air Force Base in 1958. From that time to the 1960s, the Air Force acquired additional holdings in the southern portions, including the Sudden Ranch, until its present configuration was reached. Today, Vandenberg AFB is the third largest Air Force base in the continental United States.

After the USAF acquired the lands that comprise Vandenberg AFB, their use related primarily to construction of missile launch and support facilities, and the launching of space vehicles. The original buildings from the Sudden Ranch developments have been removed from the Spaceport area, but two relatively modern complexes of buildings remain. The first of these is a Coast Guard Rescue Station, known as the Boathouse, built at Boathouse Flats between 1936 and 1938 (USAF 1983). Although deactivated in 1952, the station retains historical value as one of the few West Coast examples of the U.S. Colonial revival style of architecture. The second complex of buildings is another Coast Guard Station located at Point Arguello.

The SLC-6 site was originally constructed in 1970 for the Titan IIIM space launch vehicle (USAF 1988). This was to support the Manned Orbital Laboratory (MOL). In the 1980s, SLC-6 was modified in anticipation of Space Shuttle launches at VAFB. Neither the MOL nor the Space Shuttle programs were implemented and SLC-6 has been in a caretaker status since the cancellation of the Space Shuttle Program. Although SLC-6 was not used in Cold War activities, it is currently being evaluated for inclusion in the National Register of Historic Places (NRHP) by the Army Corps of Engineers Construction Engineering Research Laboratory (CERL).

The Cypress Ridge alternative site has also been considered for development as a space launch facility. Construction was never implemented at the Cypress Ridge site. Space Launch Complex 7 (SLC-7) was proposed on the south slopes of Cypress Ridge for launches of the Titan IV and the Titan IV/Centaur rockets (USAF 1989a). The purpose of this rocket launching program was to lift heavy payloads in the 4,536 kg (10,000 lb) class into polar and highly inclined orbits. The SLC-7 site would have been 700 m (2,300 ft) long, 305 m (1,000 ft) wide and about 21.5 ha (53 acres) in size.

SLC-5 was developed to launch Scout rockets. This Space Launch Complex is currently in an inactive state. The location for the SLC-5 north alternative site is undeveloped except for roads, power lines and other transportation and communication networks.

## 3.3 Land Use and Demography

### 3.3.1 Vandenberg Air Force Base

Launch operations are the primary mission at Vandenberg AFB (Engineering Science 1992). It is the headquarters of the 30th Space Wing (30 SW), Air Force Space Command. Over 1,700 launches have been conducted since 1958. Among these, space boosters of all sizes have inserted more than 500 unmanned satellites into polar and high-inclination orbits.

Vandenberg AFB occupies approximately 6 percent of the total land area of Santa Barbara County (USAF 1988). Sixty percent of the VAFB is open space and recreation area. An additional 30 percent is used for grazing and other forms of agriculture. The remaining 10 percent of the land is occupied by facilities and operations associated with U.S. Air Force activities.

South Vandenberg is almost entirely devoted to open space and grazing uses (USAF 1989a). Isolated areas of South Vandenberg are used for Air Force activities such as space launch complexes, mountain-top tracking stations, and facilities for administrative and industrial functions.

Vandenberg AFB has a base comprehensive plan (USAF August 1989). The objectives of this plan, with respect to space and missile operations, include: 1) to continue supporting Air Force Space Command, 2) to incorporate flexibility that will permit adaptation to changes in technology and reserve land to allow for proposed or unforeseen future needs, 3) to continue to perform the space and missile operations in a safe manner to protect the welfare of the base and the surrounding communities, 4) to continue to minimize the detrimental effects to the natural environment of VAFB, and 5) to continue to work with public interests in the area without jeopardizing the necessary base operations. Potential constraints that could limit, or be limited by, future launch facility operations include incompatible land uses on adjoining properties, oil production, transportation structures and electrical substations, and public access to coastal beaches.

### 3.3.2 Western Santa Barbara County

According to the 1990 census, Santa Barbara County supports a population of 369,608 people, most of whom live near the Pacific Coast (U.S. Bureau of the Census 1993). Lompoc, with a population of 37,649, is the nearest populated area to South Vandenberg. Farther to the north, Santa Maria, with a population of 61,284, is second in size only to Santa Barbara, with 85,571 people.

The largest employers in the area of Santa Barbara County surrounding Vandenberg AFB are services, retail trade, government, and manufacturing. In 1985, the area's employment level was 101,600, an increase of approximately 50% in 10 years with most growth occurring in the manufacturing sector. Projections are for employment to increase to 145,800 by 2005, a 43% increase from employment levels in 1985. The unemployment rate is currently 5% and is projected to remain between 5% and 5.5% through the year 2005. The primary constraints to growth will be water and residential land shortages in some areas.

The number of persons employed at Vandenberg AFB has declined from approximately 16,000 in 1985 to less than 10,000 currently. Of these, approximately 68% are civilian employees. The base generates about 4,300 jobs for the local economy, and has an overall monetary impact of more than $500 million on the surrounding region. Vandenberg AFB employs approximately 40% of Lompoc's labor force and 9% of Santa Maria's.

Two large ranches, the Bixby Ranch and the Hollister Ranch, are located more than 16 km (10 mi) to the southeast of the Spaceport (USAF 1989a). The traditional use of these ranches has been cattle grazing.

### 3.3.3 Recreation

The Pacific Coast, in the vicinity of Vandenberg AFB, provides numerous opportunities for public recreation (USAF 1989a). This includes five local parks operated by the Santa Barbara County Parks Department and the State of California: 1) Rancho Guadalupe County Park, 2) Point Sal Beach State Park, 3) Ocean Beach County Park, 4) Jalama Beach County Park, and 5) Gaviota Beach State Park. Two of these recreation areas are adjacent to South Vandenberg. The first, Ocean Beach County Park, is located 12.1 km (7.5 mi) to the north of the proposed Spaceport at the mouth of the Santa Ynez. The second, Jalama Beach County Park, is situated at the mouth of the Jalama River, near the eastern boundary of VAFB and about 12.9 km (8.0 mi) to the southeast of the proposed Spaceport.

Jalama Beach County Park is the only recreation area that is near the downrange launch trajectories from the Spaceport (see Figure 2.10). It is reached via Jalama Road from State Highway 1. Access to the beaches extends to the north of the park for approximately 2.4 km (1.5 mi). Amenities at the park include picnicking and other day use activities, as well as approximately 100 sites for overnight camping. The Santa Barbara County Parks Department has estimated attendance in recent years to be approximately 300,000 visitors per year.

Portions of the coastline on VAFB are also accessible to the public, either directly from the ocean or indirectly from the contiguous public beach areas. Vandenberg AFB offers 14.8 km (9.2 mi) of coastline to the public. Two segments of the coastline are accessible; one north of Jalama Beach and the other at Ocean beach.

### 3.3.4 Coastal Resources

The California Coastal Commission is the state agency responsible for reviewing federal projects for consistency with the California Coastal Act. The three alternative sites for the proposed project lie within the Coastal Zone.

Public recreation areas, such as Jalama Beach, would not be affected by construction or operation of the Spaceport. The California Coastal Commission has found the California Spaceport project (CC-42-94) to be consistent to the maximum extent practicable with the California Coastal Management Plan.

## 3.4 Atmospheric Resources

### 3.4.1 Regional Atmosphere

The climate in the vicinity of VAFB is Mediterranean (Schmalzer et al. 1988). This is characterized by warm, dry weather from May to November and cool, wet weather from December to April. The Pacific Ocean has a moderating influence on the weather patterns at VAFB.

At the VAFB Airfield, the average annual temperature and the mean annual relative humidity are 12.8$^{O}$ C (55$^{O}$ F) and 77 percent, respectively. The average precipitation is 32.3 cm (12.7 in) per year. This ranges from 6.6 cm (2.6 in) in February to less than 0.3 cm (0.1 in) in July. More than 90 percent of this precipitation falls between November and April. Coastal fog and low clouds are common in the morning hours, especially during the summer months when inversion conditions intensify.

Monitoring of atmospheric resources relative to regional air quality is conducted at two sites on VAFB. The first of these is on Watt Road, near the VAFB Airfield. The second air monitoring station is located adjacent to the SLC-6 power plant, about 1.6 km (1.0 mi) north of the Spaceport. Comparisons of the wind patterns and mixing heights for these locations indicate that the wind direction shifts approximately 30 degrees from the north to the south (Figure 3-2). The topographic characteristics of Vandenberg AFB affect the wind patterns. The airfield is on a flat plateau on North Vandenberg. At the Vandenberg Airfield, the wind is predominantly from the north-northwest (NNW). During the winter months, the incidence of winds from the east-southeast (ESE) increases to 20 percent of the time. Occasionally, winds blow from the other directions. The average monthly wind speed ranges from a low of approximately 5 knots in August to a high of 7.8 knots in March.

In contrast to the Vandenberg Airfield, the site of the proposed Spaceport, which is located on South Vandenberg, is nearer to the ocean and on a terrace adjacent to a ridge. The predominant wind flow is from the north (N). The wind at the Spaceport site flows from the north at the same time as the wind measured at the airfield is flowing from the NNW. During winter months, there is a much more frequent shift to a southeast flow than an equivalent shift at the airfield. The monthly average wind speed measured at SLC-6 ranges from a low of 7.5 knots in January to 10.5 knots in July. Unlike the data from the airfield, the SLC-6 measured wind speed is higher in the summer than in the winter.

The normal Mediterranean climate patterns can be interrupted by Santa Ana winds (Fredrickson et al. 1991). These winds result from inland high pressure cells which cause warm, dry northeasterly winds to descend down the mountain slopes to the Pacific Coast. They most commonly occur during the fall and winter months. Santa Ana winds can last from several hours to several days. During these periods, the relative humidities decrease to less than 10 percent, while temperatures increase accordingly. Wind speeds typically average 13 to 17 knots, but can attain speeds of 52 knots. The mixing height of the atmosphere demarks the upper limit of the atmospheric region where pollutants and emissions generally remain. Higher mixing heights will facilitate dispersion of any trapped air pollutants. The mixing height is controlled by the location in the atmosphere of the first layer of air that is warmer than the air below. The location of the mixing height also depends on wind conditions and the amount of heating of the ground by the sun. A system of calculating mixing heights has been developed which includes the instabilities induced by wind and sunshine (USAF 1974). These are categorized according to Pasquill Stability Classes A through G.

Representative mixing heights at the Vandenberg Airfield are summarized and presented in Figure 3-3. The first panel of Figure 3-3 displays the maximum monthly average mixing height reported for any stability class. The second panel focuses on Stability Class C as an average condition. In this panel, the mixing heights for this stability class are displayed by the direction of windflow.

At Vandenberg AFB, the average maximum mixing height ranges from approximately 900 m (2,950 ft) above sea level in July to 1,350 m (4,430 ft) above sea level in November. The mixing height also tends to increase as the winds originate from the north and the west, and decrease as the winds flow from the east. Most frequently, the atmosphere at Vandenberg is nearly neutral in stability (Pasquill Stability Class D). Unlike wind data, there are no data comparing mixing heights at the airfield and SLC-6. Unpublished observations indicate that a slightly lower mixing height occurs at the site of the proposed Spaceport than at the airfield (Steve Sambol, personal communication, 1993).

### 3.4.2 Air Quality

Vandenberg AFB and Santa Barbara County are in the South Central Coast Air Basin (SCCAB). With respect to air quality, Santa Barbara County is divided into North County and South County (Fredrickson et al. 1991). South County includes the region south of the crest of Santa Ynez Mountains and east of Jalama Beach (see Figure 1.1). Vandenberg AFB is entirely in North County.

Monitoring of ambient air pollution concentrations is conducted by the California Air Resources Board (ARB), the Santa Barbara County Air Pollution Control District (APCD), and industry (Fredrickson et al. 1991). Monitoring operated by the ARB and the APCD are part of the State and Local Air Monitoring System (SLAMS). The SLAMS monitors are located to provide local and regional air quality information. Monitors operated by industry are called Prevention of Significant Deterioration (PSD) Stations. PSD stations are required to ensure that new and modified sources do not interfere with the County's ability to attain and maintain air quality standards.

The Watt Road air monitoring station is a PSD site (Fredrickson et al. 1991). SLAMS sites are located at Herado Street (northwest of Lompoc), on H Street, (downtown Lompoc), and in downtown Santa Maria. The air monitoring station at the SLC-6 power plant is a PSD unit. Additional PSD sites are located at Point Arguello, north of Lompoc, Jalama Beach, and Point Conception.

Five criteria pollutants, as defined by the Clean Air Act (CAA), are monitored by VAFB. These pollutants are ozone ($O_3$), carbon monoxide (CO), nitrogen dioxide ($NO_2$) and sulfur dioxide ($SO_2$), and particulate matter under 10 microns in diameter ($PM_{10}$). In addition, the Air Force monitors for total hydrocarbons (THC) and meteorological data. Table 3-1 presents a summary of recent air quality measurements, as well as air quality standards defined by the CAA and the State of California. Many

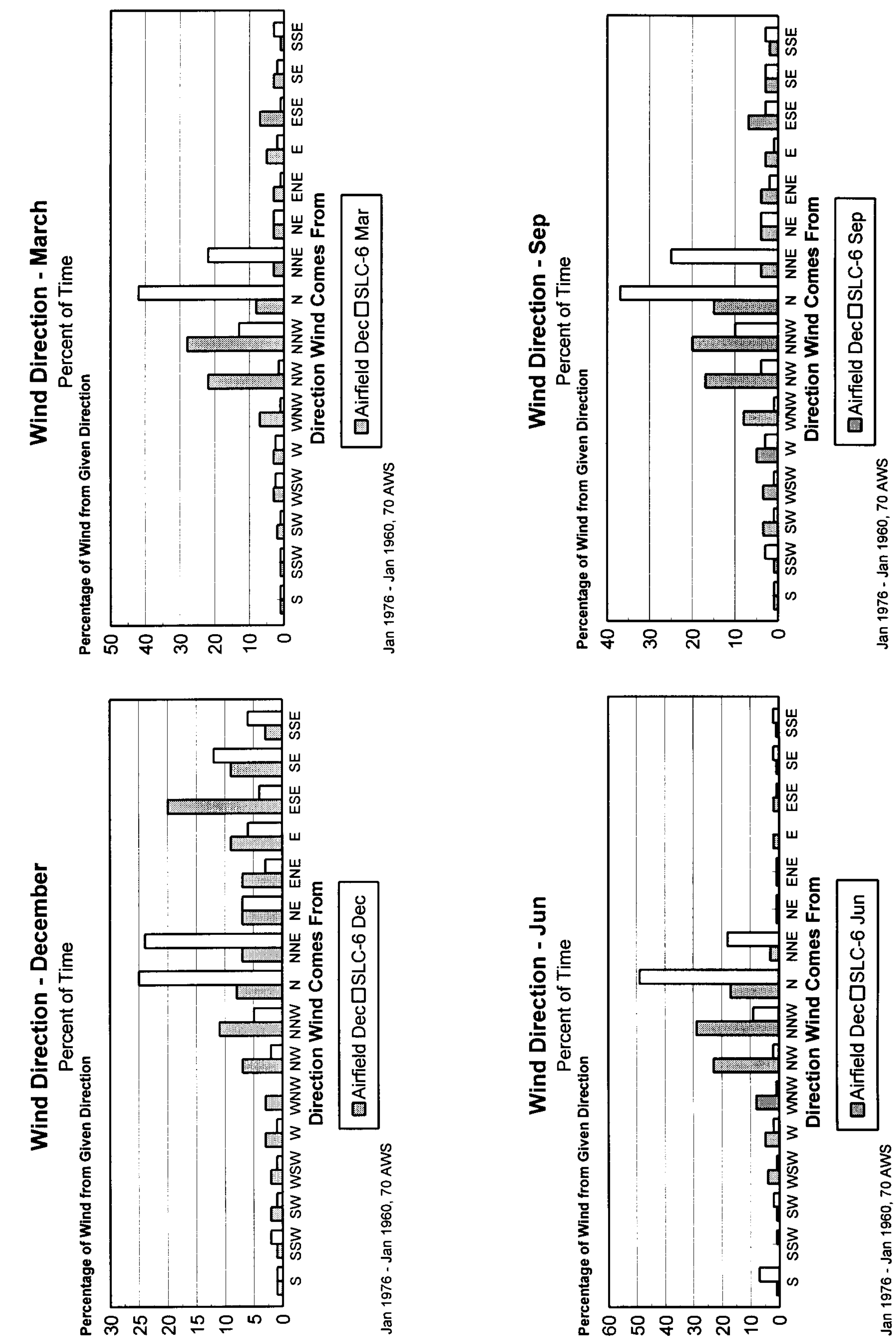
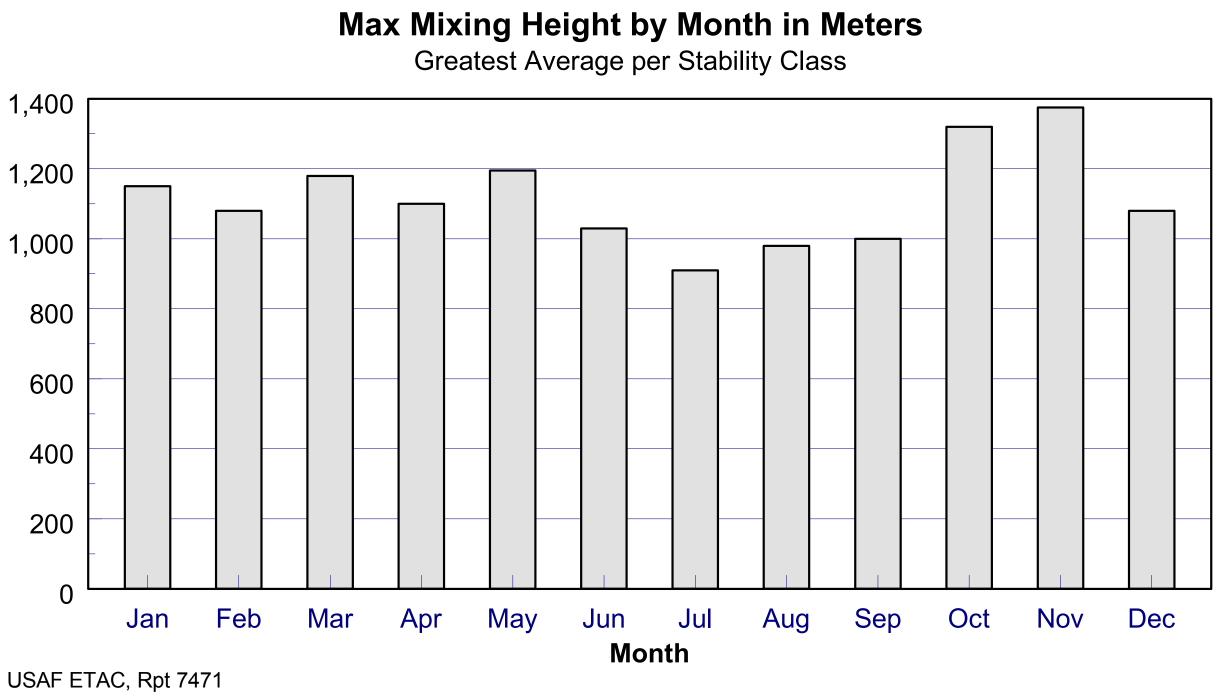



Figure 3.2. Wind Direction Summaries, Vandenberg AFB



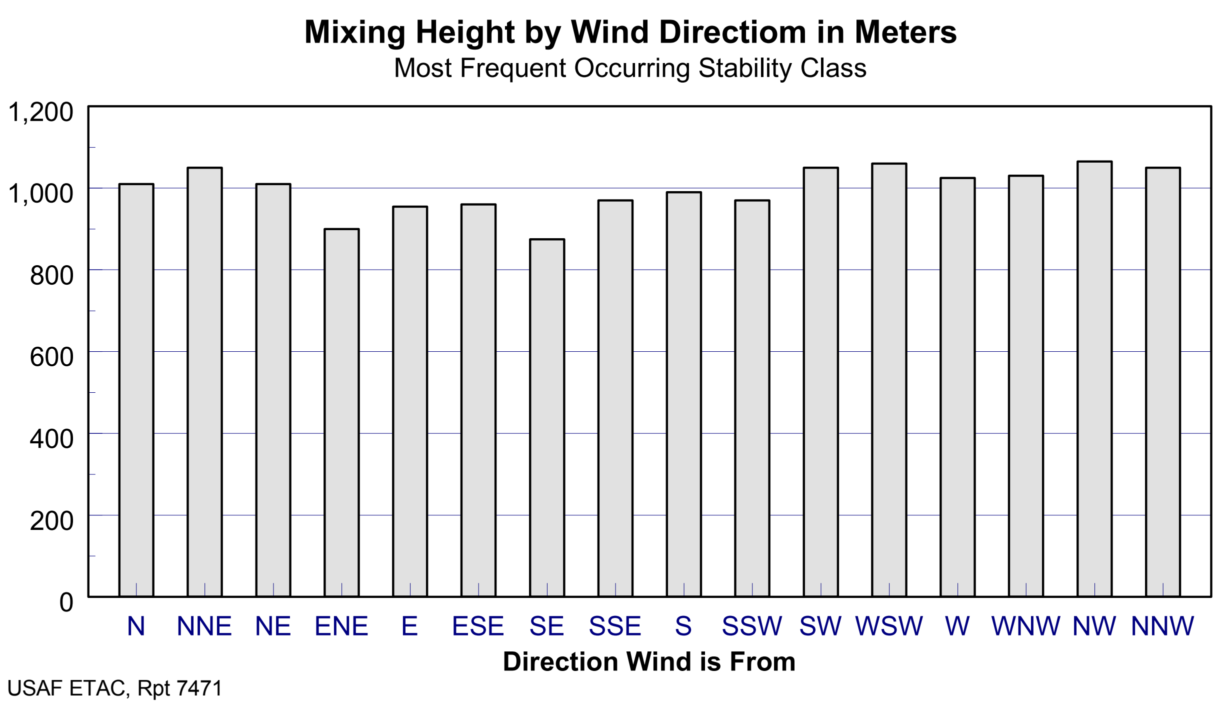




Figure 3.3. Mixing Height Summaries, Vandenberg AFB

sections of Santa Barbara County are not in attainment of the National Ambient Air Quality (NAAQ) standards (Fredrickson et al. 1991). Both the primary National and California health standards for ozone have been violated in South County and North County in recent years. For all monitoring stations, Santa Barbara County experiences between 30 and 45 days per year on which the state ozone standard is violated and 2 to 8 days per year on which the National standard is violated. All of Santa Barbara County is designated a moderate nonattainment area for the federal and state ozone standards (V. Jammalamadaka, APCD, personal communication to M. Real, VAFB, 1994).

The $PM_{10}$ levels at the Santa Maria SLAMS site are in violation of both the California maximum 24-hour average concentrations and California annual geometric mean standards. However, the National standards for maximum 24-hour $PM_{10}$ concentrations are not in violation at this site. Similarly, the annual arithmetic mean $PM_{10}$ concentrations are in compliance with the National standards at Santa Maria. Although, Goleta occasionally violates the California 24-hour $PM_{10}$ standards, the overall frequency of its violations is less than Santa Maria (Fredrickson et al. 1991). Santa Barbara County is a nonattainment area for the state $PM_{10}$ standard (V. Jammalamadaka, APCD, personal communication to M. Real, VAFB, 1994).

Table 3-1. Vandenberg AFB Air Quality Data

| Pollutant | Highest Measured Concentration | | California Ambient Air Quality Standard BNA 321:0101 Article 15 | National Ambient Air Quality Standard 40 CFR 50.6 |
|---|---|---|---|---|
| | Watt Road VAFB Mar - Sep ‘93 (a) | South VAFB Power Plant Oct ‘92 - Nov ‘93 (a) | | |
| Ozone ($O_3$) | | | | |
| 1-hour average (ppm) | 0.085 | 0.087[b] | 0.09 | 0.12 |
| Carbon Monoxide (CO) | | | | |
| 1-hour average (ppm) | 1.2 | 1.0 | 20.0 | 35.0 |
| 8-hour average (ppm) | 1.0 | 0.8 | 9.0 | 9.0 |
| Nitrogen Dioxide ($NO_2$) | | | | |
| 1-hour average (ppm) | 0.015 | 0.046 | 0.25 | No Std |
| Sulfur Dioxide ($SO_2$) | | | | |
| 1-hour average (ppm) | 0.005 | 0.008 | 0.25 | No Std |
| 3-hour average (ppm) | 0.003 | 0.007 | No Std | 0.5[c] |
| 24-hour average (ppm) | 0.001 | 0.004 | 0.05 | 0.14 |
| Suspended Particulate with aerodynamic diameter less than 10 microns ($PM_{10}$) | | | | |
| 24-hour average ($\mu g/m^3$) | 42.0 | 48.9 | 50.0 | 150.0 |
| Annual geometric mean ($\mu g/m^3$) | NA | NA | 30.0 | No Std |
| Annual arithmetic mean ($\mu g/m^3$) | NA | NA | No Std | 50.0 |

(a) Source: Environmental Monitoring Company, 1993
(b) Levels violated the Federal Ozone Standard in July, 1992
(c) National Secondary Standard

### 3.5 Land Resources

### 3.5.1 Topography

The area surrounding the proposed site for the Spaceport is located in the extreme southwest portion of VAFB in an area of complex topography (Schmalzer and Hinckle 1987). Cypress Ridge descends from Tranquillon Ridge to the coastline, separating coastal South Vandenberg into two portions; one that faces toward the west and one that faces toward the south (Figure 3.4). Tranquillon Ridge is the western extremity of the Santa Ynez Mountains. The highest points in the area include the Tranquillon Mountain, at 658 m (2,159 ft) above mean sea level (msl), and Wild Horse Peak, at 506 m (1,659 ft) above msl.

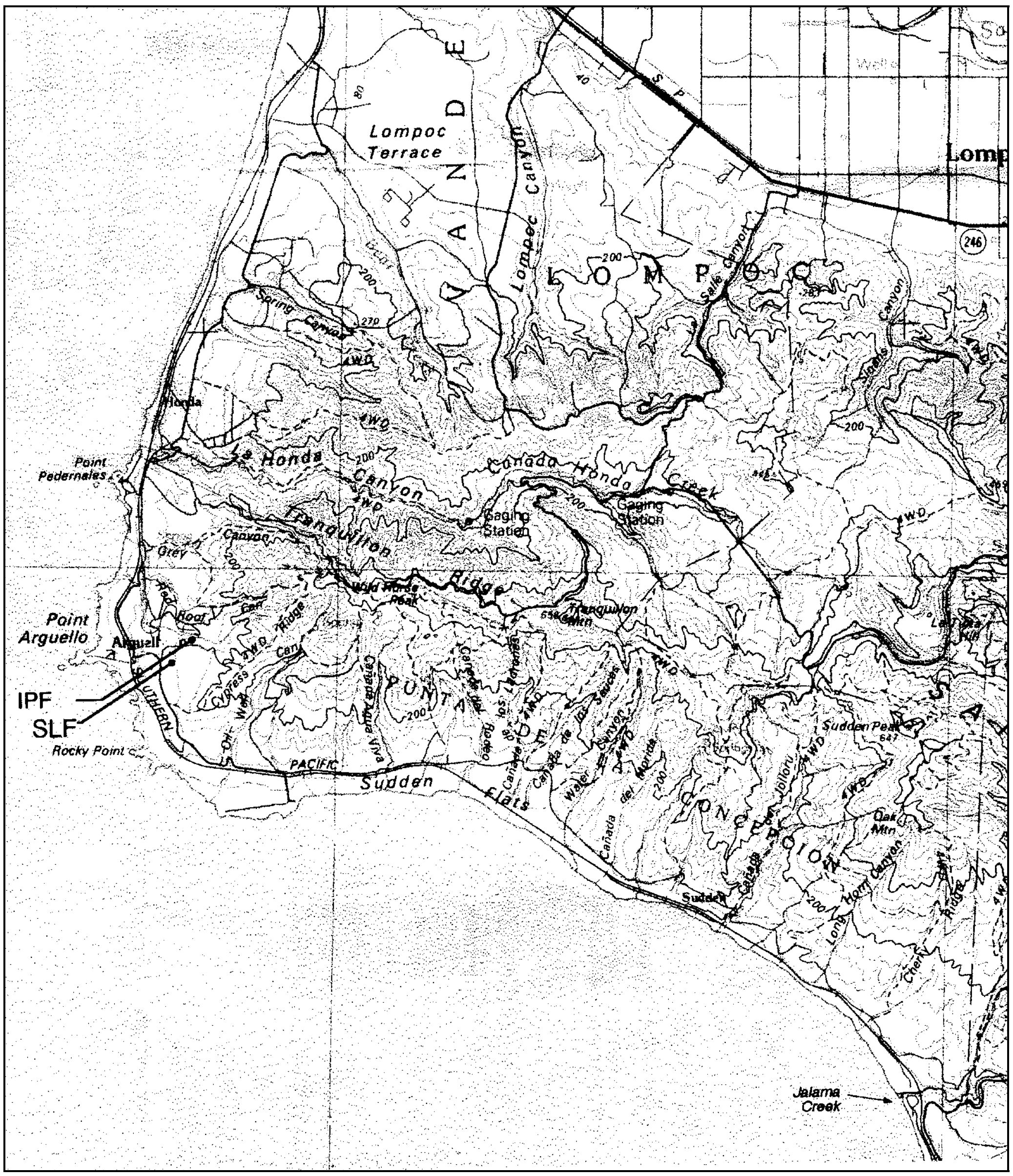



Figure 3.4. Topographic Map of South Vandenberg and Vicinity

The IPF is located on the west-facing slopes, about 1.8 km (1.1 mi) to the north of Cypress Ridge (Figure 3.4). The proposed location for the SLF is 0.61 km (0.38 mi) to the southwest of the IPF. Both of these sites are on or near SLC-6, which is to the east of Point Arguello and Coast Road.

The coastline to the west of the proposed site is rocky, with steep cliffs of 30 m (100 ft) or more. Point Arguello, about 1.6 km (1.0 mi) to the west of the proposed Spaceport, is the most prominent feature on this portion of the coastline. Point Pedernales and Rocky Point are also significant coastline features. These coastline features are about 2.4 km (1.5 mi) to the north and to the south of the Spaceport site, respectively.

To the south of Cypress Ridge, the land slopes more gently to the Pacific Ocean. The steep, oceanside cliffs of the area near Point Arguello are replaced by gradual slopes and flats which descend to the coastline. Boathouse Flats and Sudden Flats are typical of this gently sloping topography. The Boathouse, approximately 4.0 km (2.5 mi) from the Spaceport, is the most prominent cultural feature on this section of the coast.

The aspects of the slopes near the proposed Spaceport are to the west (Schmalzer and Hinckle 1987). The average aspect is 266.4 degrees, while the average slope is 7.8 percent. The slope ranges from 4 percent to 9 percent. The slope aspects at the alternate Cypress Ridge site and the SLC-5 North alternative site are toward the south and west respectively.

Prominent drainages to the north of the proposed Spaceport include Cañada Honda Creek, Spring Canyon, Bear Creek, and the Santa Ynez River. The Santa Ynez River is the only major drainage of South Vandenberg. Cañada Honda Creek parallels the north side of Tranquillon Ridge. The distances of these and other drainages from the proposed Spaceport are listed in (Table 3-2).

The IPF is bounded to the north and south by intermittent drainages. The northerly drainage, Red Roof Canyon, passes to the northwest and combines with Grey Canyon before exiting into the Pacific Ocean. The southerly drainage extends from a canyon east of the site to a discharge point about 0.8 km (0.5 mi) to the west-northwest. This drainage passes between the existing IPF and the proposed SLF.

To the south and east of the proposed Spaceport, the nearest drainages include Oil Well Canyon, Cañada Agua Viva, Cañada del Rodeo, Cañada de los Ladrones, Cañada de los Sauces, and Water Canyon. Several other minor canyons drain the southerly slopes from Water Canyon to Jalama Creek.

The Channel Islands are an east-west chain of mountainous outcrops in the Pacific Ocean, which lie to the southeast of VAFB. The major islands in this system include, from west to east, San Miguel Island, Santa Rosa Island, Santa Cruz Island, and the smaller Anacapa Islands. The approximate sizes of the three major islands range from 168 sq km (65 sq mi) for San Miguel Island to 388 sq km (150 sq mi) for Santa Cruz Island.

Santa Cruz Island is about 40 km (25 mi) due south of Santa Barbara and about 105 km (65 mi) southeast of the proposed Spaceport. The western island, San Miguel Island, is about 65 km (40 mi) to the south and southeast of the Spaceport.

Table 3-2. Distances from Local Drainages to the Proposed SLF

| Drainage | Kilometers | Miles |
|---|---|---|
| Jalama Creek | 14.3 | 8.9 |
| Cañada del Rodeo | 5.5 | 3.4 |
| Cañada de los Ladrones | 5.6 | 3.5 |
| Cañada de los Sauces | 6.4 | 4.0 |
| Water Canyon | 7.2 | 4.5 |
| Cañada Agua Viva | 4.2 | 2.6 |
| Oil Well Canyon | 2.4 | 1.5 |
| Grey Canyon | 2.1 | 1.3 |
| Cañada Honda Creek | 3.7 | 2.3 |
| Spring Canyon | 6.9 | 4.3 |
| Bear Creek | 8.9 | 5.5 |
| Santa Ynez River | 13.2 | 8.2 |

### 3.5.2 Soils

The characteristics and development of soils are related to the underlying bedrock, topographic conditions, organisms and time (Jenny 1941, 1980). The most detailed soil survey of the Vandenberg area was conducted by Shipman (1972). However, this effort did not include the sections of VAFB south of Spring Canyon. The southern part of Vandenberg was mapped as part of an earlier soil survey, which did not use current classification systems (Cole et al. 1958).

The soils in the Spaceport vicinity show close coincidence with the underlying geologic structures (Figure 3.5). At the IPF, the most prominent soil is the Tangair Loamy Sand, which is derived from ancient sand dunes (Johnson 1983). Baywood Loamy Sand and Arguello Shaly Loam are found to the south, at the site of the proposed SLF. This is consistent with the results of a recent survey in the vicinity of the SLF (Mitchell 1994). To the northeast of the IPF, the slopes at the base of the Tranquillon Ridge consist of rhyolite rock and soils, whereas Santa Lucia stony soils predominate to the southeast.

The soils immediately to the southeast of the IPF were sampled in 1986, in anticipation of the Space Shuttle program at SLC-6 (Schmalzer and Hinckle 1987). Fifty soil samples were obtained and analyzed in March 1986, and ten of these sample points were resampled in September of the same year. These data are reproduced in Appendix A. The acidity of these soils, measured from a 1:1 soil-water mixture, typically ranged from 5.0 to 6.0 pH units (mean pH = 5.5). The cation exchange capacities range from about 5.0 to 35.0 meq/100 gm (mean = 9.6). The mean percent organic matter and percent base saturation are 8.6 (sd = 4.94) and 74.2 (sd = 16.03), respectively.

The soils on the south slope of the Cypress Ridge alternative site have been mapped as Tangair loamy sand, Baywood loamy sand and Watsonvilla sandy loam (Figure 3.5). The crest of Cypress Ridge itself was mapped as Jalama and Santa Lucia soils. These soils consist of up to 50 percent sand and 10 percent organic carbon (USDA Soil Conservation Service 1973). Aquedo gravelly clay loam is the dominant soil in the Boathouse Flats.

The soils at the SLC-5 North alternative site have not been mapped. Recent site surveys indicated that they were composed of sandy loam soils and unstable to stable sand dunes.

This is an 11 x 17 foldout

Figure 3.5. Soils in the Vicinity of the Spaceport

### 3.5.3 Geology and Seismology

Physiography and surficial geology influence soil formation and hence vegetation patterns (Jenny 1941, 1980, Schmalzer et al. 1988). VAFB is situated in a region of complex and varied geology that gives rise to an equally complex pattern of topography and soils.

The recent geologic history of South Vandenberg is characterized by alternating periods of deposition and uplift (Dibblee 1950, Woodring and Bramlette 1950). The bedrock underlying the Cypress Ridge Area consists of the Upper Monterey Formation (USAF 1988). This formation has a wide distribution throughout the Santa Ynez range and is well exposed, discontinuously on upland slopes and continuously along the sea cliffs. The hills to the northeast of the proposed Spaceport are comprised of middle Miocene Tranquillon volcanic deposits. Marine terrace deposits underlie nearly all of the project area (USAF 1988). These consist of beds and gravel. The deposits vary in thickness, but are less than 30.5 m (100 ft) in thickness. Weathered material, 0.3 m (1.0 ft) to 1.5 m (5.0 ft) in depth, covers most of the land surfaces.

Within the region surrounding VAFB, oil and gas are the dominant geologic resources (USAF 1989a). These have been extracted from both onshore wells and offshore platforms. Within the boundaries of VAFB, there are no known mineral resources of economic value, other than oil and gas (Dibblee 1950), lenses of sand, silt. All of the south central coast of California is in a seismically active region (USAF 1978). In Santa Barbara County, major earthquakes have been recorded as early as 1769. In 1927, an earthquake, with Richter magnitude of 7.3, occurred approximately 32 km (20 mi) west of Point Arguello (USAF 1989a). Of the 90 additional earthquakes that have occurred in a 32 km (20 mi) radius of the VAFB since 1900, their Richter magnitudes have been 7.1 or less (Payne and Reitman 1985). The Santa Ynez fault, about 64 km (40 mi) to the east of the Cypress ridge Area, is the nearest seismically active, onshore, geologic feature (USAF 1989a). However, the inactive Cañada Honda Fault parallels the Cañada Honda Creek, about 4.3 km (2.5 mi) to the north of the Cypress Ridge Area.

## 3.6 Water Resources

### 3.6.1 Surface Water

The western Santa Ynez Mountains receive an average annual precipitation of about 41 cm (16 in) per year, with a runoff rate of two to three inches per year (USGS 1985). South VAFB has no permanent lakes, impoundments, rivers, or floodplains. However, several local drainages discharge directly into the Pacific Ocean. The flow rates associated with these drainages can be highly variable. Many of them flow only during storm events. Intense episodes would be expected to give high intermittent yields due to the relatively steep topography of the area. Some of the drainages are spring fed, although ground percolation frequently traps the water flow before it reaches the ocean.

Cañada Honda Creek occupies a watershed of about 31 $km^2$ (12 $mi^2$) in area, which is the largest drainage in South Vandenberg (Mahrdt et al. 1976). Springs associated with the Cañada Honda Fault maintain a minimal flow of water for about one-half of the creek's length. The two drainages immediately adjacent to SLC-6 flow only during rainy periods. Erosion control ditches have been constructed on the north side of SLC-6 to direct surface water runoff into the Red Roof Canyon. Oil Well Canyon is fed by two springs near its upper reaches, although surface flow at its mouth is intermittent. Cañada Agua Viva is also a perennial drainage that is fed by two springs near Wild Horse Peak. Yields from this drainage are expected to be less than five gallons per minute or 60 acre feet per year. The individual watershed areas for Oil Well Canyon and Cañada Agua Viva are each about one square mile.

Current water quality data for Oil Well Canyon and Cañada Honda Creek are included in Appendix B. In general, these streams are high in hardness, alkalinity, and specific conductance, but low in acidity, chemical oxidation demand, and total organic carbon. These streams also have high levels of certain elements such as calcium, iron, magnesium, and sodium.

### 3.6.2 Ground Water

The underlying Monterey shale supports a minimal amount of ground water in the fracture zones (USAF 1989a). The lower member of this formation contains greater amounts of water than the upper member. The depths to the water table vary from 21 m (70 ft) to 40 m (131 ft).

Samples taken at four of the wells near the IPF indicate that the quality of the ground water is low (USAF 1982). Three parameters, dissolved solids, hardness, and chloride were measured at high levels (Table 3-3). These are compared with the respective State of California and EPA standards.

Table 3-3. Selected Ground Water Parameters

| Parameter | Mg/L | Standard |
|---|---|---|
| Dissolved Solids | 150 | 500 |
| Hardness | 617 | 400 |
| Chlorides | 343 | 250 |

## 3.7 Biological Resources

Vandenberg AFB is recognized as a biologically important area (Coulombe and Cooper 1976, Coulombe and Mahrdt 1976, URS Corporation 1987). Vandenberg AFB occupies a transition zone between the cool, moist conditions of northern California and the semi-desert conditions of southern California (USAF 1989a). Consequently, many plant species, as well as plant communities, reach their northern or southern limits in this area (Munz 1974, Coulombe and Cooper 1976, Smith 1976, Howald et al. 1985). Plant communities of particular interest include tanbark oak forest, bishop pine forest, Burton Mesa chaparral, coastal dune scrub, and a variety of wetland types (Schmalzer et al. 1988, USAF 1989a). However, none of these communities occurs within the vicinity of the proposed Spaceport at the preferred alternative site.

The Region of Influence (ROI) for this project, as shown in Figure 3.6 includes that area of South Vandenberg AFB from the California Spaceport site north to Honda Canyon and Point Pedernales, west to Point Arguello, South to Boathouse Flats, and east to Cypress Ridge. Vandenberg's coastline within the ROI is occupied by several species of seabirds, marine mammals and other species of interest (Table 3-4). Harbor seals, protected under the Marine Mammal Protection Act, use the beaches south of Rocky Point as haulout and pupping areas. Southern sea otters also feed in the offshore kelp beds and occasionally come onshore. Peregrine falcons nest on the rocky cliffs. Western gulls, brown pelicans, pigeon guillemots, pelagic cormorants, rhinoceros auklets, black oystercatchers and Brandt's cormorants use the rocky outcrops for roosting or nesting purposes. Three miles of the coast along Vandenberg AFB are protected under agreement with the State of California as a marine ecological reserve. This area extends from Lookout Rock (1 mile north of the United States Coast Guard House) to Point Pedernales.

Figure 3.7 depicts this area graphically. Vandenberg AFB has initiated a memorandum of agreement with the California Department of Fish and Game for access to these areas for military operations and scientific research only.

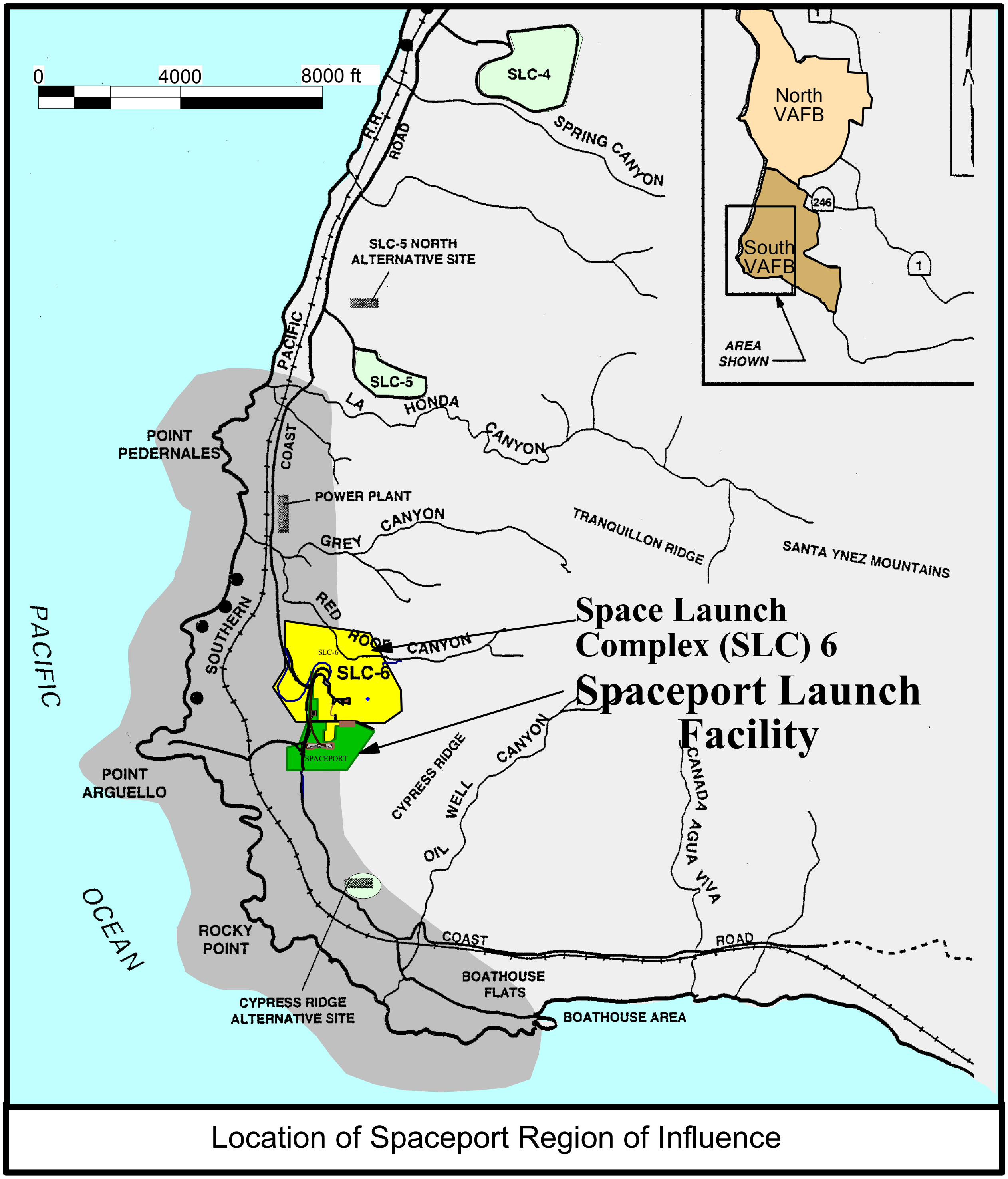



Figure 3.6. Spaceport Region of Influence

Table 3-4. Species of Special Interest in the Spaceport Vicinity

| Threatened/Endangered Species | Status[1] |
|---|---|
| FISH | |
| Unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni*[2] | FE |
| Tidewater goby, *Eucyclogobius newberryi*[2] | FE |
| REPTILES/AMPHIBIANS | |
| California red-legged frog, *Rana aurora*[2] | FPE |
| BIRDS | |
| American peregrine falcon, *Falco peregrinus anatum*[2] | FE |
| California brown pelican, *Pelecanus occidentalis californianus*[2] | FE |
| Western snowy plover, *Charadrius alexandrinus nivosus* | FT |
| MAMMALS | |
| Southern sea otter, *Enhydra lutris nereis*[2] | FT |
| **Candidate Species** | Status[1] |
| INVERTEBRATES | |
| White sand bear scarab beetle, *Lichnanthe albopilosa* | C2 |
| REPTILES/AMPHIBIANS | |
| Southwestern pond turtle, *Clemmys marmorata pallida* | C1 |
| Two-striped garter snake, *Thamnophis hammondii* | C2 |
| California tiger salamander, *Ambystoma californiense* | C2 |
| South coast garter sanke. *Thamnophis sitalis ssp*. | C2 |
| Silvery legless lizard, *Anniella pulchra pulchra* | C2 |
| California horned lizard, *Phrynosoma coronatum frontale* | C2 |
| BIRDS | |
| Bell's sage sparrow, *Amphispiza belli belli*[2] | C2 |
| Southern California rufous-crowned sparrow, *Aimophila ruficeps canescens* | C2 |
| Western burrowing owl, *Speotyto cunicularia hypugea* | C2 |
| PLANTS | |
| Surf thistle, *Cirsium rhothophilum*[2] | C1 |
| Spectacle pod, *Dithyrea maritima*[2] | C1 |
| Crisp monardella, *Monardella crispa*[2] | C2 |
| San Luis Obispo Monardella, *Monardella frutescens*[2] | C2 |
| Black flowered figwort, *Scrophularia atrata*[2] | C2 |
| MAMMALS | |
| San Diego desert woodrat, *Neotoma lepida* | C2 |
| **Other species or habitats of interest** | |
| Harbor seal, *Phoca vitulina richardsi*[2] | |
| Burrowing owl, *Speotyto cunicularia*[2] | |
| Pinniped haulout and breeding areas | |
| Seabird nest and roost sites | |
| Wetland and riparian habitats | |

[1] FE = Federally listed as Endangered
FT = Federally listed as Threatened
FPE = Officially proposed for listing as Endangered
C1 = Category 1 candidate for federal listing as Endangered or Threatened
C2 = Category 2 candidate for federal listing, but for which substantial biological information to support a proposed rule is lacking

[2] Documented within the region of influence. Other species are likely to occur.

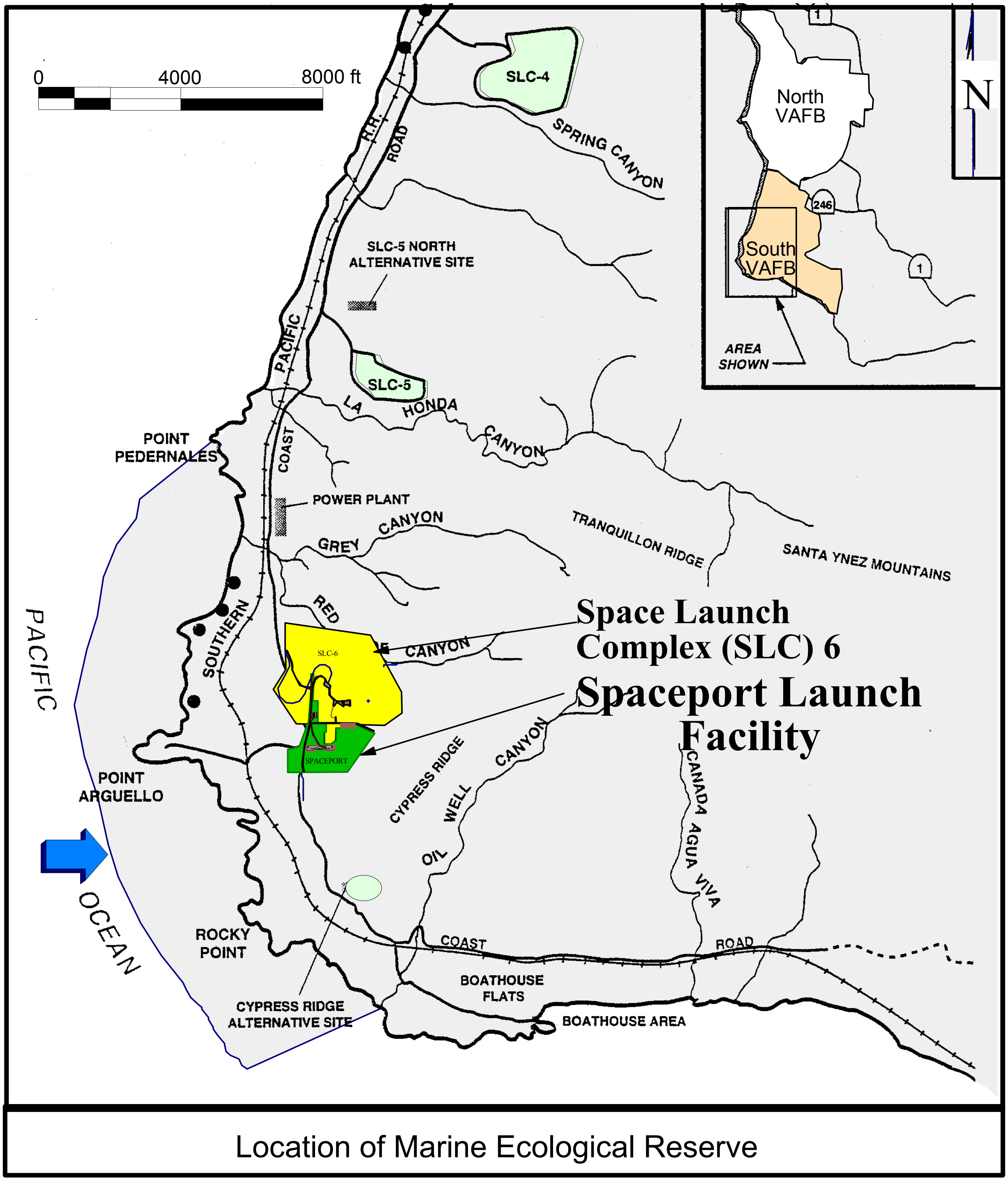



Figure 3.7. Marine Ecological Reserve

Terrestrial animal life at South Vandenberg consists of species common to coastal sage scrub, grassland, and chaparral communities (USAF 1989a). The riparian vegetation of many local drainages provides important habitat for wildlife. Widely ranging species which frequent the area include coyote, bobcat, mule deer, and red-tailed hawk. The region has also been used for cattle grazing for at least 60 years (USAF 1989a).

### 3.7.1 Natural Vegetation

The vegetation composition in the vicinity of the Spaceport is shown in Figure 3.8. Due to the predominance of southerly and westerly exposures in this area, the vegetation is primarily central coastal scrub or coastal sage scrub, grassland, and chaparral community types (Schmalzer and Hinckle 1987, USAF 1987b, Environmental Solutions 1989). These communities are adapted to periodic burning, and many plant species resprout readily after fire (USAF 1989a). Where disturbances are more frequent and intense, ruderal and exotic species replace the native vegetation. Many of the local canyons and drainages support riparian woodlands (Mahrdt et al. 1976).

#### 3.7.1.1 Vegetation Surveys

A recent vegetation map produced from LANDSAT thematic mapper data indicates that the vegetation on the terraces at the location of the preferred alternative site of the proposed Spaceport are predominated by coastal sage scrub and grasslands (Chris Gillespie, USAF, personal communication, 1993). Figure 3.8 thru 3.11 on the following pages show a scale drawing of the Spaceport project footprint and the distribution of plant species.

The vegetation at the preferred alternative site was qualitatively surveyed in September, 1994, and quantitatively sampled in early November, 1994. Standard vegetation sampling methods, including 10 m line intercept and visual estimation procedures, were used to produce percent canopy coverage data (Mueller-Dombois and Ellenberg 1974). Details are provided in Appendix C.

According to the LANDSAT vegetation map, *Salvia leucophylla* and grass species are more prominent components of the plant communities at the Cypress Ridge site. On the northern exposures of the slopes to the southeast of the Spaceport, huckleberry and salal become more dominant (USAF 1989a). Similarly, southerly slopes to the northeast of the Spaceport support chaparral vegetation, dominated by *Ceanothus impressus*. Grasslands predominate on the Boathouse Flats.

Schmalzer and Hinckle (1987) established a system of fifty 15 m transects which they sampled for vegetation and soils in March and September of 1986. These transects were located to the southeast of the IPF. The plant species with the highest coverages include *Baccharis pilularis*, *Artemisia californica*, *Stipa pulchra*, *Bromus carinatus*, and *Salvia spathacea*. The average proportions of exposed bare ground in the transects was 2.5 percent in March and 8.6 percent in September. Throughout this analysis, *Monardella spp.* was not observed.

Qualitative surveys were recently conducted at the preferred alternative site to assess the distributions of plant communities and the abundances of plant species (C. Gillespie, VAFB and R. Balice, LESAT, September 1994). A list of the plant species encountered is included as Appendix C. The slopes to the east of the Coast Road and the ridge slopes were dominated by Coastal Sage Scrub vegetation, while mixtures of grasslands and scrub vegetation became more prominent in the alluvial areas at the base of the Tranquillon Ridge. The most common plant species included *Artemisia californica*, *Baccharis pilularis*, and *Haplopappus venetus*. In the grasslands, *Stipa pulchra* and other grasses become more common. On the ridge slopes, *Lupinus chamissonis*, *Mimulus aurantiacus*, *Pteridium aquilinum*, and *Salvia spathacea* are common components of the Coastal Sage Scrub vegetation. *Monardella spp.* was not encountered during this survey.

11 x 17 foldout

Figure 3.8. Plant Communities in the Vicinity of the Spaceport

Figure 3.9. Vegetation Composition in the Vicinity of the Spaceport Launch Facility

Figure 3.10. Vegetation Composition in the Vicinity of the Operations Support Building and Rail Spur Connection

Figure 3.11. Vegetation Composition in the Vicinity of Bldg 330 Showing Communications Line and Power Relocation

A recent vegetation survey was also conducted at the Cypress Ridge site (C. Gillespie, VAFB and R. Balice, LESAT, July 1994). This survey indicated that coastal sage scrub vegetation predominates on the upper slopes, whereas grasslands become more prominent on lower slope positions. In the footprint of the proposed launch pad-SCF complex, the vegetation is two-thirds coastal sage scrub vegetation and one-third grassland.

The vegetation at the SLC-5 North site is a combination of Coastal Sage Scrub and Coastal Dune Scrub communities (J. Pollard, R. Balice, LESAT, June 1994). Coastal Sage Scrub is the dominant vegetation along the roads and towards SLC-5, to the east. At the intersection of Delphy Road and the Old Surf Road, common plant species include *Artemisia californica*, *Ericameria ericoides*, *Lotus scoparius*, *Mimulus aurantiacus*, and *Carpobrotus edulis*. *Scrophularia californica* was also encountered, but not *S. atrata*. Monterey cypress has escaped cultivation and become naturalized in this area. Coastal Dune Scrub vegetation becomes more prominent to the west of the site, toward the coast. *Monardella crispa* was encountered in the disturbed sand dunes.

#### 3.7.1.2 Candidate Plant Species

Several plant species are of special concern to this environmental analysis (Table 3-4). These are discussed below.

##### 3.7.1.2.1 Surf Thistle and Spectacle Pod

Surf thistle, *Cirsium rhothophilum*, and spectacle pod, *Dithyrea maritima*, are found on active dune systems along the Pacific coastline of VAFB. In South Vandenberg, they have been found between Point Arguello and Point Pedernales (Figure 3.12). These Category 1 plant species have not been observed on the terraces in the vicinity of the preferred alternative site nor on the slopes of Cypress Ridge.

##### 3.7.1.2.2 Monardella

Two closely-related species of *Monardella* occur on active dunes, stabilized dunes, and in disturbed habitats. Although, hybrids are common where these two species coexist, a recent taxonomic treatment separates them according to their morphological characteristics and exacting soil requirements (Hickman 1993). Crisp monardella, *M. crispa*, prefers unstabilized dunes and disturbed habitats, whereas San Luis Obispo monardella, *M. frutescens*, is most common on inactive dunes and in coastal sage scrub vegetation. Both species of *Monardella* are listed as Category 2 candidates for federal listing.

A recent survey for *Monardella spp.* was conducted on South Vandenberg (J. Pollard, R. Balice, LESAT, July 1994). *Monardella frutescens* is a prominent component of the coastal sage scrub vegetation on the portions of the Cypress Ridge alternative site, adjacent to the Coast Road and along the 122 m (400 ft) elevation contour. It was also observed on both sides of the Coast Road immediately to the north of Cypress Ridge (Figure 3.13). *Monardella crispa* was not observed in the Cypress Ridge area. However, this species was found on the unstable dunes which are adjacent to the Coast Road, at the site of the SLC-5 North Alternative SLF. In a separate survey, neither of these species of *Monardella* were observed at the preferred alternative site (C. Gillespie, VAFB, R. Balice, LESAT, September 1994).

##### 3.7.1.2.3 Black-flowered Figwort

Black-flowered figwort, *Scrophularia atrata*, is an endemic plant species that maintains a patchy distribution in moist swales, with willows and coyote brush, *Baccharis pilularis* ssp. *consanguinea*. This Category 2 species is found on the diatomaceous and calcareous hills around Lompoc, as well as in coastal sage scrub and similar types of vegetation. Among the verified occurrences of black-flowered figwort, those in the Cañada Honda Creek and Cañada Agua Viva are the closest to the Spaceport (Figure 3.14). Small populations of figwort were also found along Coast road near Point

Arguello (Environmental Solutions 1990a). It was not clear, however, if these plants represented black-flowered figwort or the more common California figwort, *Scrophularia californica*. With respect to this, Smith (1983) found that most populations of figwort show evidence of hybridization. Moreover, Schmalzer and Hinckle (1987) recorded the presence of California figwort, but not black-flowered figwort, in their sampling to the south of the IPF.

*Scrophularia atrata* was not observed during recent surveys of the SLC-6, Cypress Ridge and the SLC-5 North areas (C. Gillespie, VAFB, J. Pollard, R. Balice, LESAT; July 1994 and September 1994). However, *S. californica* was observed to the west of SLC-5 and to the east of the Coast Road, in the coastal sage scrub vegetation.

### 3.7.2 Wetlands

Existence of a seepage area with standing water and plants indicative of wetlands were noted on-site during initial site familiarization visits. The question of the possible existence of wetlands on or near the proposed spaceport construction site was raised at this time. A wetlands delineation effort and preliminary wetlands determination was conducted on October 6 - 7, 1994 (Dames & Moore, 1994).

Wetland delineation and preliminary wetland determination were performed according to methods specified in the "Corps of Engineers Wetlands Delineation Manual". On-site procedures included visual survey of the site with 100 percent coverage, and analysis of soil characteristics and wetland delineation data collection at 20 sites. Each site was scored for hydrology, vegetation, and soils characteristics. Information was recorded on "Data Form 1 - Wetland Determination" forms developed by the Army Corps of Engineers for wetland delineation.

The coastal terrace vegetation within the proposed site is a mosaic of coastal sage scrub and coastal grassland. Soils collected from 19 of the 20 sites in or near the proposed spaceport occur within the soil phase classification Baywood loamy-sand. One location had soils which appeared to occur in the Arguello shaley loam soil phase. Neither phase appears on the list of hydric soils in Appendix D of the "Corps of Engineers Wetlands Delineation Manual".

Based on the presence of inundation and saturated soils, wetland hydrology is present at two of the twenty locations sampled: (1) a ditch east of the former storage facility pad, and (2) a pool of water in a trench south of the waste water retention ponds. The ditch is on-site and is discussed further below. The approximately 2 ft. by 30 ft pool is outside the limits of construction for the proposed spaceport. None of the remaining 18 locations surveyed displayed dominant hydrophytes, wetland hydrology, or general characteristics of hydric soils.

The on-site drainage ditch was excavated to divert runoff from an asphalt storage pad. It is located adjacent to the pad at the foot of a steep (approximately 1:1), unvegetated cut slope. The approximate dimensions of the ditch are 3 ft by 110 ft (.008 acre). It is surrounded by unvegetated terrain. The ditch itself contains sparse hydrophytic flora, contains water throughout parts of the year, and consists of soils and substrates with some hydrophytic characteristics. Each of these qualities is man-induced. Based on its relative absence of vegetative cover and its location, the ditch and immediately surrounding area is of low habitat value. In view of the above conditions, it is unlikely that the Corps of Engineers would exercise jurisdiction over the aforementioned non-tidal ditch, pursuant to Section 404.

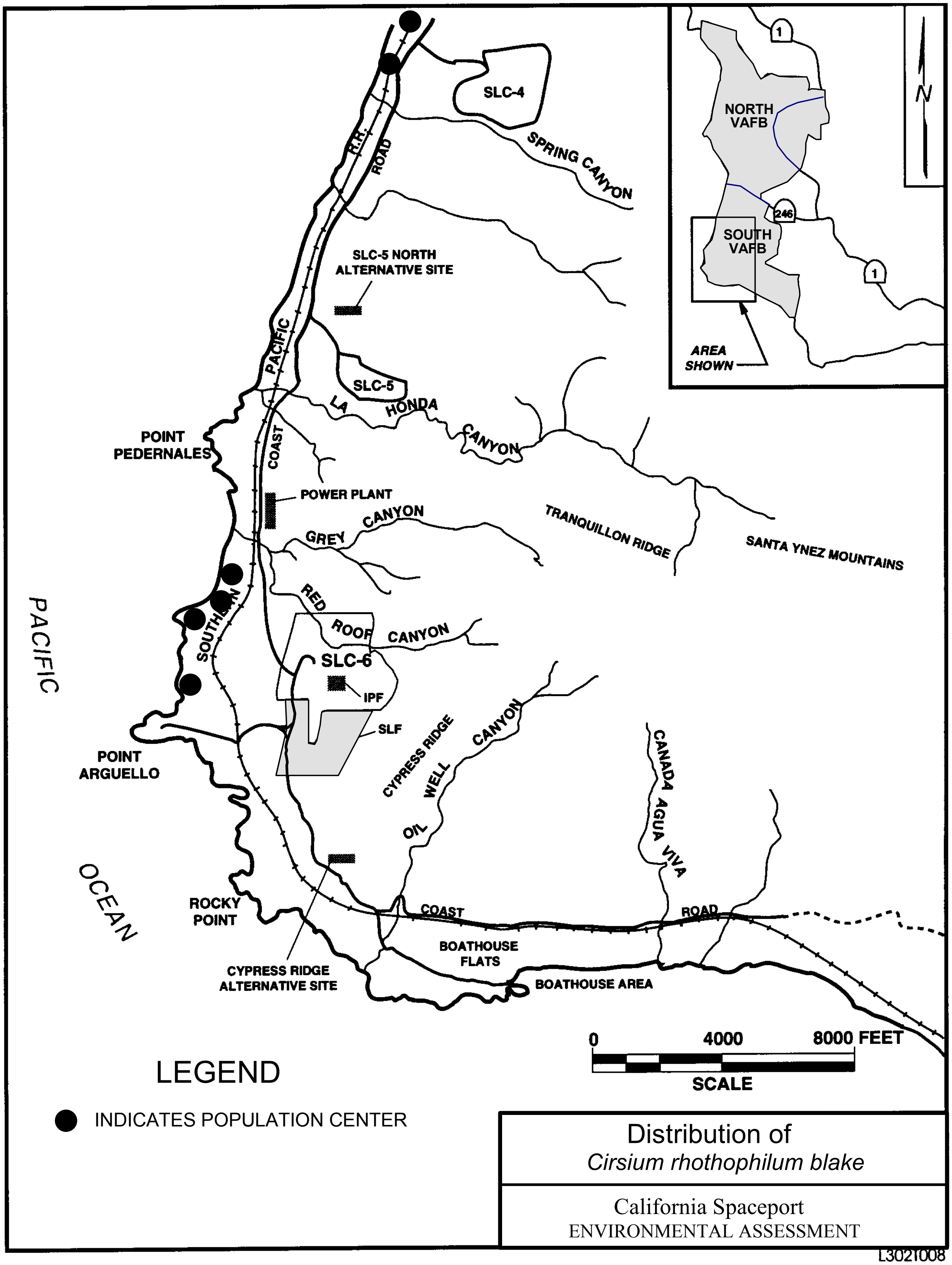



Figure 3.12. Distribution of *Cirsium rhothophilum*

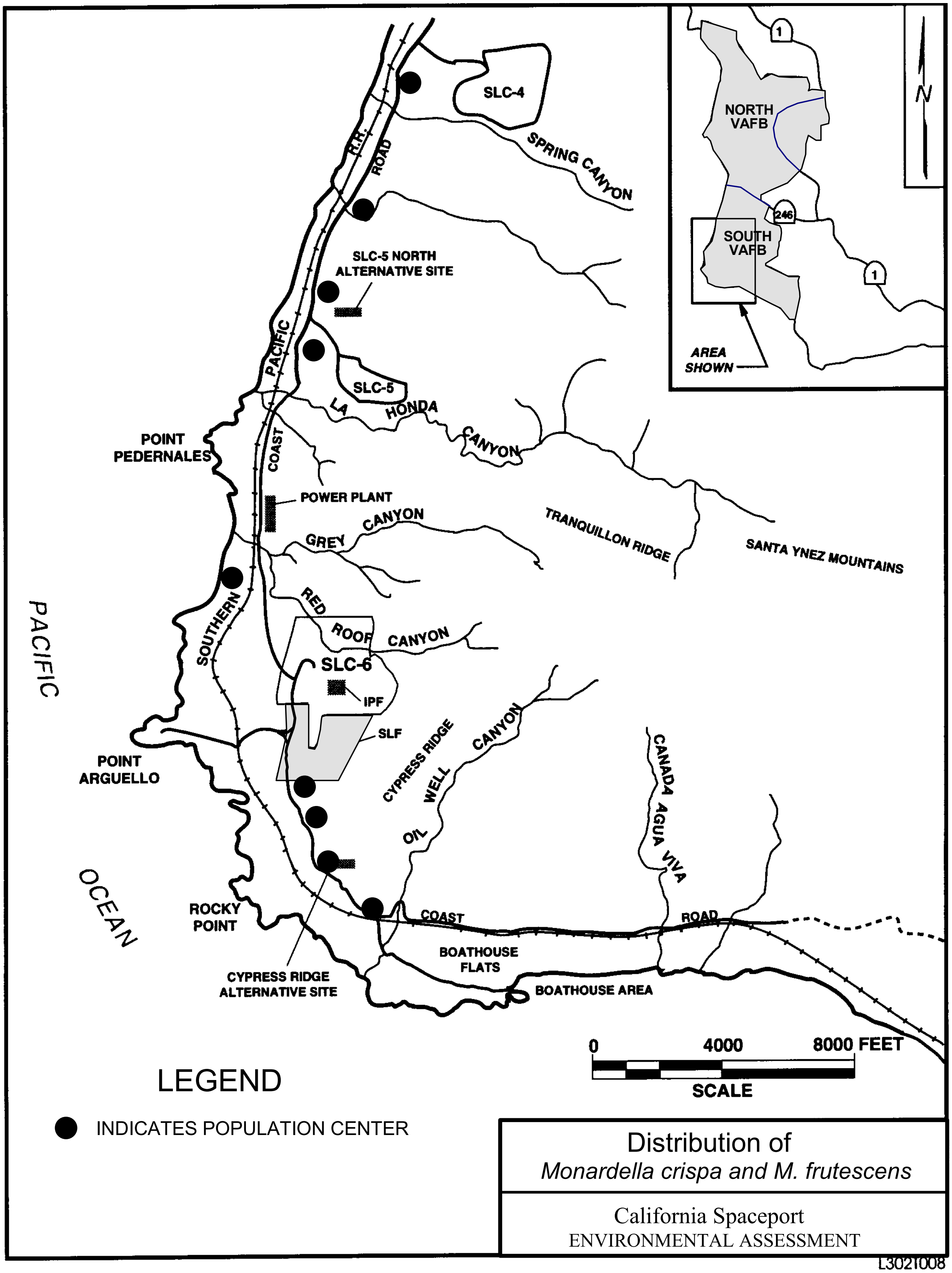



Figure 3.13. Distribution of *Monardella spp.*

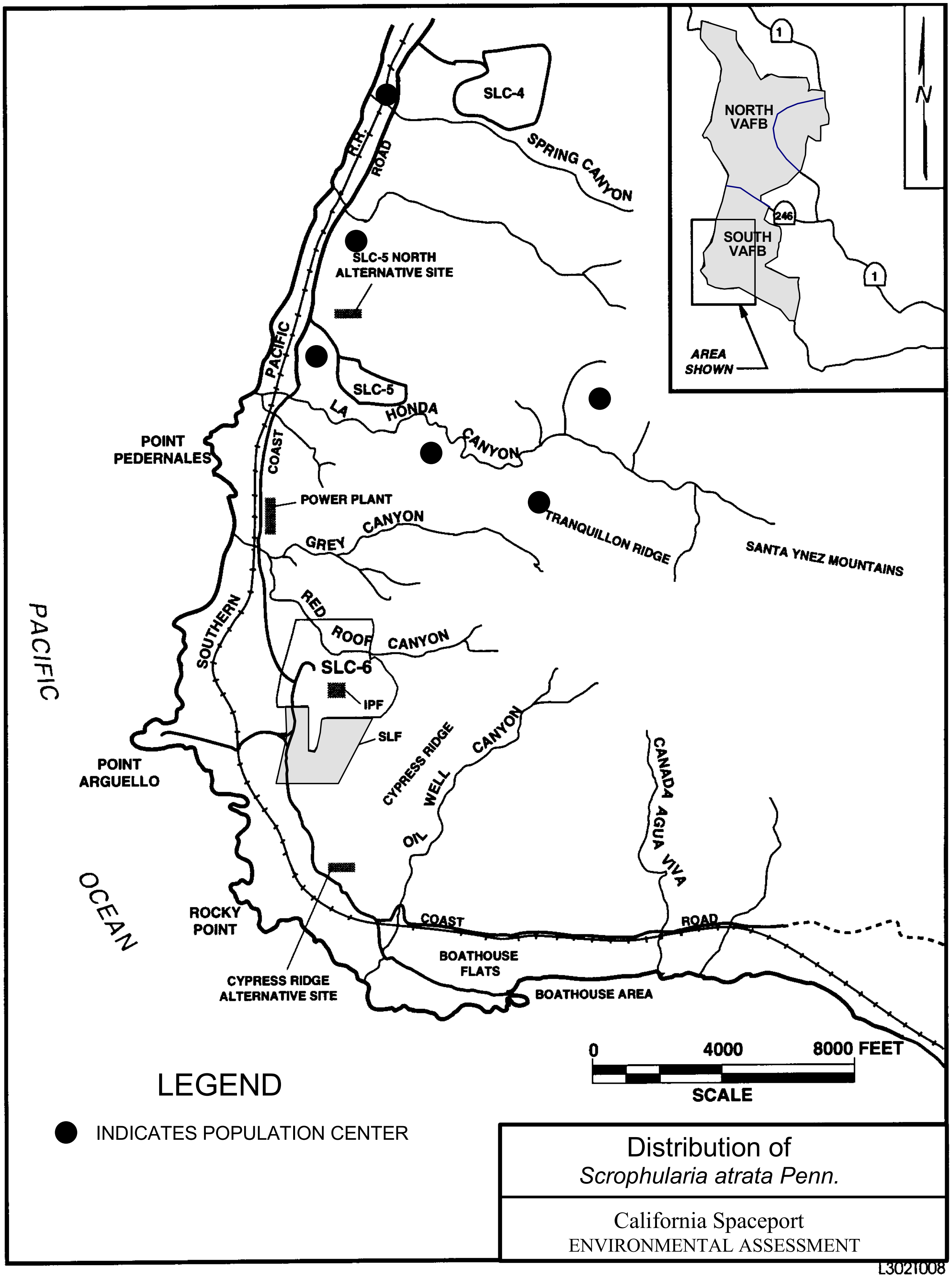



Figure 3.14. Distribution of *Scrophularia atrata.*

### 3.7.3 Wildlife

#### 3.7.3.1 Wildlife Surveys

Many species which are common in Coastal Sage Scrub vegetation were observed in a recent survey of the preferred alternative site (N. Read, VAFB, September 1994). These include mule deer, badger, coyote, desert cottontail rabbit, turkey vulture, red-tailed hawk, American kestrel, white-tailed kite, and northern harrier. In addition to raptors, a variety of other bird species were encountered; including loggerhead shrike, rufous-sided towhee, and Bell's sage sparrow. Evidence for burrowing owl was noted in the grassland areas. Although rufous-crowned sparrows were not observed there is a strong potential for their occurrence based on habitat.

Recent, qualitative biological surveys were conducted at the site of the preferred alternative Spaceport and at the alternative sites. Species of special interest within the ROI of the proposed Spaceport are listed in Table 3-4.

#### 3.7.3.2 Candidate Species

Candidate species are those which are under consideration by the USFWS as candidates for listing as threatened or endangered species. As such their status is under current review by the USFWS. Bell's sage sparrow, *Amphispiza belli belli*, and the burrowing owl, Speotyto cunicularia have been observed within the project's area of influence (Nancy Read, VAFB, personal communication, 1993). Furthermore, the habitat suggests strong potential for occurrences of the southern California rufous-crowned sparrow, *Aimophila ruficeps canescens*. These Category 2, upland songbird species could potentially nest, and occur as year-round residents, on the terraces surrounding the preferred alternative site for the construction of the Spaceport, on the slopes of Cypress Ridge, and surrounding the SLC-5 North alternative site.

##### 3.7.3.2.1 Burrowing Owl

The burrowing owl, *Speotyto cunicularia*, nests in rodent burrows throughout much of the southwestern United States where it lives in open grasslands, prairies, dikes, deserts, and farmlands (Peterson 1961). In recent years, this species suffered substantial reductions in population sizes, including a "precipitous decline" in California (L. Hayes, USFWS, personal communication to N. Read, VAFB, 1994). Several burrowing owls were recently observed on the east-central portions of the Cypress Ridge alternative site (W. Mader, R. Balice, February 11, 1994). However, they were not observed at this site during a subsequent survey (J. Pollard, R. Balice, LESAT, June 28 and 29, 1994). Evidence for the burrowing owl was noted in the grassland areas to the southeast of SLC-6, adjacent to the preferred alternative site (N. Read, VAFB, September, 1994).

##### 3.7.3.2.2 Bell's Sage Sparrow

The distribution of the sage sparrow extends from the Great Basin and the Snake River Plain to the southern deserts of the United States, and southern California (Peterson 1961). From the San Francisco Bay area to San Diego, the Bell's sage sparrow, *Amphispiza belli belli*, occurs within 113 km (70 mi) of the Pacific coast (Grinnell and Miller 1944). The preferred habitat of this subspecies includes dense chaparral and brushy sand dunes (Grinnell and Miller 1944, Bent 1968). In South Vandenberg, it would be expected to occur sparingly in the coastal sage scrub, particularly among *Baccharis pilularis* and *Artemisia californica*.

##### 3.7.3.2.3 Rufous-crowned Sparrow

The rufous-crowned sparrow is a resident of central and southern California, as well as Arizona and southern New Mexico (Peterson 1961, Robbins et al. 1966). The distribution of the southern California (ashy) rufous-crowned sparrow, *Aimophila ruficeps canescens*, extends from the Santa

Maria area to the border with Mexico (Grinnell and Miller 1944). This coincides with the range of its preferred habitat, coastal sage vegetation (Bent 1968). It is most abundant in open plant communities with sparse coverage.

**3.7.3.2.4 Southwestern Pond Turtle**

In Southern California, the southwestern pond turtle, *Clemmys marmorata pallida*, is found in unpolluted rivers and streams, as well as other freshwater habitats, particularly pools lined with aquatic vegetation (Stebbins 1985, Environmental Solutions 1990a). However, habitat degradation and collecting for the pet trade have decreased the population levels in many areas. Within the vicinity of the proposed Spaceport, pond turtles have been found in Jalama Creek, at the Hollister Ranch, and at the Bixby Ranch (Howald et al. 1986). The habitat at Cañada Honda Creek is also suitable for pond turtles.

**3.7.3.2.5 California Horned Lizard**

The California horned lizard inhabits a variety of upland habitats in central California; on Vandenberg it is found in open scrub and grassland habitats, typically in sandy areas, and is often found near anthills. Ants are its preferred food. Newly recognized as a candidate species, its distribution on Vandenberg is not well understood. It is expected to occur in the ROI of one or more of the alternative facility sites.

**3.7.3.2.6 Silvery Legless Lizard**

The silvery legless lizard is a secretive burrowing species, typically found in leaf litter under shrubs, where it feeds on insects, insect larvae, and spiders. It requires sandy or loose organic soils. It is relatively widespread in coastal and valley habitats of central and southern California. On Vandenberg it is common but seldom observed in coastal dune scrub vegetation, typically under dune lupine (*Lupinus chamissonis*). Its distribution on South Vandenberg in the vicinity of the alternative sites is not known but it is expected to occur within the ROI of one or more of the alternative facility sites.

**3.7.3.3 Additional Candidate Species**

Table 3-4 also lists several plant and animal species which are not currently threatened or endangered, but are of concern nevertheless. Little is known about the population status of the invertebrates on VAFB, as well as many of the reptiles and amphibians. For instance, the population levels and the biological requirements of the white sand bear scarab beetle, *Lichnanthe albopilosa*, the two-striped garter snake, *Thamnophis hammondii*, the south coast garter snake, *Thamnophis sirtalis ssp*., the California tiger salamander, *Ambystoma californiense*, and the San Diego desert woodrat, *Neotoma lepida intermedia*, at Vandenberg AFB are poorly understood. Although there are minimal data on these species, they occur, or have strong potential to occur on VAFB (Nancy Read, VAFB, personal communication, 1993). The habitat within the ROI of the Spaceport provides suitable habitat for two-striped garter snakes, and south coast garter snakes (in and around riparian habitat of Honda Creek), and for the desert woodrat (in coastal sage scrub habitat). The California tiger salamander could also occur in the Honda Creek drainage; however, it is more commonly associated with annual grasslands and vernal pools (Zeiner, D.C., W.F. Laudenslayer, Jr., and K.E. Mayer. 1988. *California's Wildlife. Volume I: Amphibians and Reptiles*. Department of Fish and Game, Sacramento, California.) The information available for other species is summarized below.

**3.7.4 Threatened and Endangered Species**

Numerous plant and animal species of special interest live in or around VAFB (see Table 3-4). The threatened and endangered species are discussed below.

#### 3.7.4.1 Fish

##### 3.7.4.1.1 Unarmored Threespine Stickleback

The endangered, unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni*, occurs in several local drainages (Environmental Solutions 1990a). Of these, Cañada Honda Creek is the nearest to the Spaceport; the rest are on North VAFB. Although sticklebacks are adaptable in their temperature and food requirements, they have suffered from habitat loss due to urban and agricultural developments.

##### 3.7.4.1.2 Tidewater Goby

Historically, the tidewater goby, *Eucyclogobius newberryi*, occupied fresh or brackish water in coastal lagoons throughout much of Southern California (Miller and Lea 1972). All life stages of tidewater gobies are found at the upper end of lagoons in salinities less than 10 parts per thousand (ppt). They occur in loose aggregations of a few to several hundred individuals on the substrate in shallow water, typically less than 1.0 m (3.3 ft) deep (Swift et al. 1989).

Historically, the tidewater goby occurred in at least 87 coastal lagoons of California (Swift et al. 1989). In southern California, this range extends from Morro Bay to San Diego. Since, 1900 it has disappeared from 74 percent of its former habitat (Irwin and Soltz 1984, Howald et al. 1985). Near the proposed Spaceport, the tidewater goby currently inhabits the coastal lagoons and portions of the river channels of the Santa Ynez River and Jalama Creek. It has also been observed in Honda Creek. The tidewater goby is adversely affected by road widening and bridge construction, water diversion projects, commercial and residential developments, ground water overdrafts, agricultural and sewage effluents, river channelization and cattle grazing.

#### 3.7.4.2 Reptiles and Amphibians

##### 3.7.4.2.1 California Red-legged Frog

California red-legged frogs, *Rana aurora*, were proposed for listing as Federally endangered in February 1994. Listing for this species has not yet been finalized by USFWS. This species is found in freshwater pools and ponds associated with arroyo willow, cattails, and other thickets of emergent aquatic vegetation (Environmental Solutions 1990a). However, this species has significantly declined during the past century because of degradation and loss of critical habitat, predation from introduced freshwater fish, and competition from introduced bullfrogs, *Rana catesbeiana* (Hayes and Jennings 1986, Jennings and Hayes 1985). In the vicinity of South Vandenberg, the red-legged frog has been found in the Santa Ynez River, Cañada Honda Creek, and Jalama Creek (Howald et al. 1985, 1986). The red-legged frog has not been observed in Red Roof Canyon, Oil Well Canyon, or Cañada Agua Viva and it appears that these riparian habitats are not suitable for this species (Environmental Solutions 1990a).

#### 3.7.4.3 Birds

##### 3.7.4.3.1 Peregrine Falcon

The Peregrine falcon, *Falco peregrinus anatum*, is known to be a year-round resident of VAFB (Nancy Read, USAF, personal communication, 1995). Migrant and wintering individuals also visit VAFB outside of the nesting season (Collins 1988). Regionally, the peregrine were severely depleted in the 1970s (Environmental Solutions 1990a). However, since the banning of DDT, they have become more numerous.

Peregrine falcons frequently nest on seaward-facing coastal cliffs and forage on nearby terraces and flats. Within the vicinity of the Spaceport, a pair of peregrine falcons presently utilize the nearby rocky cliffs and coastal habitats for these purposes.

In addition to the mainland, peregrine falcons also visit San Miguel Island and other Northern Channel Islands during winter months and migration periods (Jehl 1980). Breeding peregrines were once reduced in numbers on the Channel Islands, but are now present on San Miguel Island, Santa Cruz Island and West Anacapa Island (Environmental Solutions 1990a).

**3.7.4.3.2 California Brown Pelican**

Although the California brown pelican, *Pelecanus occidentalis californianus*, has increased in numbers during the past 10 years, it has retained its endangered status because of its low reproductive success and relatively low breeding population (Environmental Solutions 1990a). Brown pelicans are common year-round visitors to open beaches, nearshore waters, and protected bays and harbors in Santa Barbara County (Webster et al. 1980, Lehman 1982). Within the vicinity of the proposed Spaceport, they roost at Point Sal, Purisima Point, the mouth of the Santa Ynez River, and the Boathouse Breakwater (Environmental Solutions 1990a). They also roost on Point Pedernales, Destroyer Rock, Point Arguello, and Rocky Point. Nesting colonies are present on the Channel islands and on islands off the coast of Mexico (Lehman 1994).

**3.7.4.3.3 Western Snowy Plover**

The threatened western snowy plovers, *Charadrius alexandrinus nivosus*, have declined as nesting species throughout Southern California, due in part to human disturbance to their sandy beach nesting habitat (Environmental Solutions 1990a). They have been extirpated as a breeding species in southern Santa Barbara County, but continue to breed and winter along undisturbed sandy beaches on VAFB and surrounding areas. In Santa Barbara County, populations of snowy plover are larger in winter than in summer because of an influx of birds from other breeding areas (Page et al. 1986).

On and near Vandenberg AFB, the western snowy plovers nest on all sandy beaches with suitable habitat with the exception of Jalama Beach. Near the Spaceport, they winter on all of Vandenberg's sandy beaches. The nearest western snowy plover nesting area is outside the ROI for the preferred alternative (approximately 3.9 miles). It is also outside the ROI for the Cypress Ridge alternative but within the SLC-5 alternative ROI. Western snowy plovers also nest on San Miguel Island and Santa Rosa Island (Page and Stenzel 1981).

**3.7.4.3.4 California Least Tern**

The California least tern, *Sterna albifrons*, is a migratory bird species that breeds and resides in Southern California from late April to August (Massey 1977, Lehman 1982). The nearest nesting areas to the Spaceport include the mouth of the San Antonio Creek, Purisima Point, and the Santa Ynez River (Environmental Solutions 1990a). None of these sites are in the region of influence of the California Spaceport. "The localities usually selected by the least tern for nesting are broad, flat, open sand beaches, entirely devoid of vegetation" (Bent 1963b:273). This species has declined in numbers because of recreational, industrial, and residential developments, as well as the introduction of non-native predators.

### 3.7.4.4 Mammals

#### 3.7.4.4.1 Southern Sea Otter

The southern sea otter, *Enhydra lutris nereis*, is a nonmigratory species which was originally distributed from central Baja California to the strait of Juan de Fuca (Arseniev 1980, Kenyon 1981). Along the coast of California, the southern sea otter is mostly associated with kelp beds, where it feeds on sea urchins, abalone, and shallow-water fish (Jameson and Peeters 1988). Because of unrestricted fur hunting throughout the 1800's it has been severely depleted in numbers and distribution. Subsequent protection and reintroductions have allowed the southern sea otter to reoccupy portions of its original range.

Southern sea otters frequent the coastal and offshore habitats adjacent to Vandenberg AFB (Breininger 1989, Engineering Science 1992). In addition, a breeding colony is established near Purisima Point on North Vandenberg (F. Wendell, Cal. Dept. of Fish and Game, personal communication, 1994). In the South Vandenberg area, southern sea otters feed offshore in kelp beds near the Boathouse, Cañada Agua Viva, Water Canyon, Cañada del Morida, and Jalama Creek. However, there are no permanent populations of southern sea otters along the coast of South Vandenberg, at this time.

### 3.7.5 Marine Mammals

#### 3.7.5.1 Harbor Seals

The State of California has designated a three-mile area of South Vandenberg AFB as a marine ecological reserve affording additional protection for marine mammals and other wildlife. Establishment of the reserve was not intended to restrict operations from launch complexes on South Vandenberg AFB. Vandenberg AFB has initiated a memorandum of agreement with the California Department of Fish and Game to have access into the marine ecological reserve only for military operations and scientific research.

Harbor seals, *Phoca vitulina richardsi*, are protected under the Marine Mammal Protection Act. They utilize rocky coastlines and beaches on the Channel Islands and at mainland sites near the Spaceport for pupping, as well as year-round haul out activities (Stewart 1980, Environmental Solutions 1990a). They forage close to shore where they take a wide variety of medium-sized fish, including herring, flounders, and cod (Jameson and Peters 1988). In addition, harbor seals feed on bivalves, crabs, squid, and octopus.

On the coastlines of South Vandenberg, harbor seals have been noted near Point Arguello, at the mouth of Oil Well Canyon, in the area surrounding Rocky Point, and near the Boathouse Breakwater. The distances of these haul-out areas from the SLF range from 0.8 km (0.5 mi) to 2.5 km (1.6 mi). In 1986, 500 harbor seals were counted at these sites. The largest aggregations occurred during the spring and early summer.

# 4.0 ENVIRONMENTAL CONSEQUENCES

Potential sources of environmental impacts are 1) the use of the Integrated Processing Facility (IPF) for preparing launch vehicles and payloads, 2) construction of the Spaceport Launch Facility (SLF), and 3) rocket launches at the SLF. These will be discussed below and addressed relative to each resource throughout this section.

Sources of potential impacts to the environment from the construction and operation of the Spaceport include construction activities, the use of hazardous materials, creation of exhaust plumes, rocket motor noises, sonic booms, and habitat loss. The potential impacts associated with these sources will be discussed in this section. Monitoring would be conducted to evaluate impacts which may be significant and mitigation measures would be initiated to offset potentially significant impacts.

There would be no construction at the IPF. Alterations to the IPF would be limited to internal modifications to the Payload Processing Room (PPR) and other support facilities. Building demolition or the removal of load-bearing walls would not be required. The removal of polychlorinated biphenyls (PCBs) would also not be required. Finally, modifications to the IPF would not result in the generation of hazardous wastes or industrial wastewater.

There would be construction of new facilities at the SLF, including a new road and a rail spur that would allow vehicle and rail car access into the complex from existing transportation routes. New facilities to be constructed include a launch duct, two Stack and Checkout Facilities (SCFs) and an Operations Support Building (OSB). Parking lots and other associated support areas would also be constructed. Less than 4.6 ha (11.4 ac) of soil and natural vegetation at the SLF would be removed or disturbed. The effects of construction would be minimized by design constraints and implementation of mitigation measures to offset habitat loss (See Appendix G).

Potential environmental impacts resulting from rocket launches at the SLF include those resulting from the presence of hazardous materials during launch preparation activities. Impacts could also occur from the launch exhaust plumes, launch noises, and sonic booms. Issues related to construction of the SLF, modifications of the IPF, and rocket launches at the SLF are discussed, as appropriate, in the following sections.

The Lockheed Launch Vehicle (LLV) family of launch vehicles will be used as a design baseline for the purposes of this environmental analysis. This choice is justified because the LLV represents a "worst case" for all potential rockets, or families of rockets, that might be launched from the Spaceport. The LLV 1 represents one of the smaller rocket types, and the LLV 3 represents the largest. The LLV 2 represents intermediate sized vehicles. The LLV uses common "off-the-shelf" solid rocket motors for propulsion.

## 4.1 Cultural Resources

### 4.1.1 Integrated Processing Facility

Development of the IPF would involve modifications to the SLC-6 PPR. These would include cleaning, general repair, organization of existing documentation, parts inventories, cosmetic renovations to the control room, installation of communications equipment, the upgrade of outdated systems such as the chilled water system and boiler system, and installation of a bridge crane for alternate access. Modification of the PPR is planned for all three alternatives.

As part of the currently proposed project, SLC-6 was evaluated for eligibility for listing on the National Register of Historic Places (NRHP). The PPR was evaluated as part of this effort. The results of this evaluation indicate that SLC-6, and the PPR within the SLC-6, are not eligible for inclusion on the NRHP (Corbitt 1994). The State Historical Preservation Officer has concurred with this determination.

### 4.1.2 Preferred Alternative

Construction of the proposed Spaceport Launch Facility (SLF) at the preferred alternative site to the southwest of SLC-6 would involve cut and fill operations and grading over an area of approximately 5.3 ha (13 ac). Excavation for new and rerouted utilities would follow the existing Coast Road. Additional components requiring earth disturbance would include construction of an operations support building at the northeast corner of N Road and Coast Road, and construction of a road near the Coast Road-N Road intersection to the SLF. Rail access would be provided by placement of approximately 2,800 ft. of new rail tracks within the roadbed of Coast Road and the new Spaceport access road. The new rail would connect with an existing rail spur near Bldg. 398. The construction lay-down area would be placed on existing fill.

Archival and background research indicates that the preferred alternative's APE was completely surveyed in association with planning for the Titan IV/Centaur Launch Complex (TCLC), which was not constructed (Environmental Solutions 1990b).

No previously unrecorded cultural resources were noted in the preferred alternative's APE during the TCLC survey. Immediately north of the APE, one prehistoric site had been previously identified during the construction of Pond A, Pond B, and N Road (Gibson 1986). This site, formally recorded as SBA-2218 during work for the TCLC, had no surface indications but consisted of 20 scattered manos and two hammerstones located at the bottom of the topsoil level, 0.76 m (2.5 ft) to 1.5 m (5 ft) below the ground surface. The artifacts were collected and construction was allowed to proceed.

Construction monitoring also located two very similar artifact clusters, SBA 2219 and SBA 2217, approximately 122 m (400 ft) west and 427 m (1400 ft) east of SBA-2218, respectively. Based on the nature and depth of these deposits, and the results of previous testing in the vicinity of SLC-6, it is not likely that traditional methods of subsurface testing would be effective in determining if similar resources exist within the APE (Gibson 1985:4). For this reason, archaeological and Native American monitoring of all project-related grading activities would be conducted. In addition, a monitoring plan would be prepared prior to the beginning of construction. The plan would outline construction techniques best suited for discovery of buried resources. It would also define testing and mitigation measures to be implemented should sites be discovered during monitoring. If cultural resources are observed during monitoring, construction would be redirected, and consultation with the California State Historic Preservation Officer (SHPO) would be initiated.

During a recent visit to the preferred alternative site, VAFB personnel observed a groundstone artifact near the northeast corner of N Road and Coast Road in the vicinity of the proposed OSB. Four shovel test pits (STPs) were subsequently excavated in 20 cm levels and the excavated material was screened through 1/8-inch mesh. The STPs were placed 10 m away, and in cardinal directions from, the mano. In addition, a 1x1 m unit was excavated in 10 cm levels immediately under the mano. The excavated material from the unit was screened through 1/8-inch mesh. No cultural material greater than 50 years of age was discovered. Several buried communications cables were discovered in the unit at about 75 cm below the ground surface.

At the preferred alternative site, the proposed Spaceport would be located approximately ten miles north, and beyond visual range, of Point Conception. Although proposed project activity within visual range of Point Conception is an issue of concern (see Cypress Ridge Alternative, below), this is not an issue for the preferred alternative site to the south of SLC-6.

The site of the preferred alternative is also located outside the viewshed of the historic Juan Bautista de Anza National Historic Trail (NPS 1994). The 1,200-mile trail is the route of Anza's 1775-1776, 240-person expedition from Tubac, Mexico to San Francisco which culminated in the founding of the presidio and mission (Garate 1993). The National Park Service (NPS) is currently preparing a Comprehensive Management and Use Plan and EIS for the trail. The vision of the NPS is that of a continuous multi-use trail within or parallel to the historic Anza corridor (M. Kaplan, NPS, personal communication, April 12, 1994).

The Anza Trail is a linear landscape resource that crosses the length of VAFB. The Trail's general location is known from primary sources, such as the Font diary, which contain references to specific villages (now known archaeological sites) along the route. The closest Chumash village site mentioned in the diaries which describe the Trail is *Nocto*, approximately two miles south of SLC-6, on the opposite (south) side of Cypress Ridge. Other than such sites, however, the Trail cannot be identified by visible features such as wagon ruts but must be considered in terms of its landscape features as referenced in the historic journals. In the vicinity of the project area, the Trail corridor, based on available documents, most likely follows the marine terrace or coastal plain about 0.4 mi. to the west and 150 ft. lower in elevation than the proposed project's APE. Consequently, the project area does not fall within the viewshed of the Trail corridor at the preferred alternative site.

The APE for the preferred alternative is located directly south of the main Shuttle complex (SLC-6). SLC-6 occupies an area of about 274 acres, and consists of a series of several very large structures among clusters of smaller structures. These structures include the 16-story Payload Changeout Room, the 20-story Shuttle Assembly Building, and a 28-story Mobile Service Tower. The SLC-6 complex was placed on a surface created by massive cut and fill operations.

The south edge of the proposed SLF is located on top of an existing paved parking lot. This parking lot was formed by a large cut at its eastern end. Immediately to the east, the proposed SLF footprint extends into an area previously graded for use as a waste water settling pond. Two additional ponds are located immediately to the north. The staging area is also planned for a disturbed area, one created from fill during the construction of SLC-6.

New construction for the preferred alternative would include flat features such as the railroad line, paved road, and launch pads, and two 165-ft (approximately 14 story) Stack and Checkout Facilities. These buildings are below the SLC-6 skyline.

The physical components of the proposed action are dwarfed by the much larger facilities at SLC-6. Only the very top of the existing SLC-6 structures are visible from the Anza Trail corridor on the lower terrace, and none of the proposed Spaceport facilities would be visible from the terrace.

**4.1.3 Cypress Ridge Alternative**

Construction of the SLF at Cypress Ridge would involve cut and fill operations and grading over an area of approximately 8.9 ha (22 ac). Excavation for new utilities would be routed along an existing road.

Literature and records reviewed for the Cypress Ridge Alternative showed nine sites recorded within a 1/4-mile radius of the project area. The Cypress Ridge APE was extensively surveyed in 1988 in association with planning for the TCLC (Environmental Solutions 1990b). At that time, three sites (SBA-1117, SBA-1149, and SBA-1941) and numerous isolates were recorded within or adjacent to the Cypress Ridge project area.

A subsequent surface survey for the Cypress Ridge Alternative re-located five isolates and one artifact grouping later recorded as site SBA-2797. Subsurface testing of SBA-2797 yielded only one additional piece of chipped stone, and the site is recommended ineligible for inclusion on the NRHP. Subsequent testing of isolate locations within the APE did not yield additional cultural materials. Subsurface testing was also conducted within a 200-ft buffer zone along APE boundaries nearest to the three sites. Results of the testing indicated that the sites do not extend into the proposed project area. Within the APE, additional testing was conducted in four widely spaced locations within areas planned for construction, and no cultural resources were noted. A report of the test excavations has been submitted to the Base Historic Preservation Officer (BHPO) (Gerber 1994). If this alternative is chosen as the site for the construction of the Spaceport, appropriate documentation would be submitted to the California State Historical Preservation Officer (SHPO) as part of Section 106 compliance.

No impact to prehistoric resources is expected to occur as a result of construction of the SLF at Cypress Ridge. However, based on buried, isolated artifacts found near sites surrounding the project area during monitoring of previous construction efforts, construction monitoring would be conducted for the SLF. If cultural resources are observed during monitoring, construction would be redirected to allow for their proper documentation and recovery, and the initiation of SHPO consultation.

The Cypress Ridge Alternative is located approximately eight miles north, and within visual range, of Point Conception. This area is described in Chumash folklore and oral tradition as the passageway through which souls of the dead depart the world (Blackburn 1975). More recent accounts have designated the area the "Western Gate". The Point Conception area is also used today by Native Americans for various ceremonial activities. Members of the local Native American community have expressed concern about the possibility of construction activities at Point Conception, or in its viewshed.

During the environmental scoping process, an ethnographic study was conducted to address this issue (Wilcoxon 1994). The study focused on past and present traditions and beliefs associated with the area, using existing documents, recent research, and interviews with members of the local Native American community. It included an evaluation of the proposed project area as a traditional cultural property according to specific criteria established in 36 CFR Part 60. The results indicated that the elaborated concept of the Western Gate originated during the 1970s and is not traditional. Therefore, the Western Gate is recommended ineligible for inclusion on the NRHP, and alterations to its viewshed do not constitute an effect to an historic property. If the Cypress Ridge alternative is selected, additional Section 106 compliance, including submittal of the evaluation document to SHPO for an eligibility determination, would be conducted.

The Cypress Ridge alternative is within the viewshed of the Anza Trail (NPS 1994, Bradley 1994). Because of the nature of this resource, impacts at this alternative site would be primarily visual. The Cypress Ridge alternative location is currently undeveloped, with comparatively little alteration of the Trail's original setting. If the Cypress Ridge alternative is selected, additional Section 106 compliance, including discussions with the SHPO, NPS, and other interested parties, would be conducted to identify potential impacts and appropriate mitigation measures.

#### 4.1.4 SLC-5 North Alternative

Construction at the proposed site north of SLC-5, located along Old Surf Road just north of Delphy Road, would involve balanced cut and fill operations over an approximately 20 acre area. Utilities would be routed to the site from Building 748 (Hut 11) about 1.5 miles north of SLC-5, east to Old Surf Road, and then south along Old Surf Road to the new launch facility. The existing Building 596 would be remodeled to provide operations support. Archival and background research indicates that five archaeological sites are recorded along the utility route, or within or near the APE, for the proposed launch facility. These include SBA-1125, SBA-1124, SBA-676, SBA-1122, and SBA-1908.

Impacts to SBA-1125, a National Register-eligible historic homestead, would be avoided by routing the utility corridor around the site. Historic sites SBA-1124 and SBA-676 are located slightly away from the roadway, and also would not be impacted by utility placement. SBA-1122 is considered ineligible for inclusion on the National Register. For this reason construction of an access road through the site from the launch facility to Building 596 would have no effect to historic properties. SBA-1908 is located on either side of Delphy Road, adjacent to the APE. The site is considered potentially eligible for inclusion on the Register. If the SLC-5 site alternative is selected, subsurface testing would be conducted adjacent to SBA-1908 to assist in placing the launch facility APE to avoid impacts to this site. In addition, all grading activities for this alternative would be monitored for cultural resources.

The SLC-5 North alternative is also within the Anza Trail viewshed. Because of the nature of this resource, impacts at this alternative site would be primarily visual. The SLC-5 complex is primarily underground, with several associated above-ground low buildings and a fence. SLC-5 has resulted in relatively little alteration to the Trail's original setting in this area. If the SLC-5 North alternative is selected, additional Section 106 compliance, including discussions with SHPO, NPS, and other interested parties, would be conducted to identify potential impacts and appropriate mitigation measures.

### 4.1.5 No-Action Alternative

The No-Action alternative would result in no impacts to sub-surface or surface prehistoric cultural resources, the viewshed of the historic Anza Trail, and the viewshed of Pt. Conception.

## 4.2 Land Use and Demography

### 4.2.1 Vandenberg Air Force Base

The Spaceport would use the existing infrastructure of VAFB. The uses would be consistent with the Base Comprehensive Plan and the mission of the Air Force at Vandenberg AFB. Less than an estimated 5 percent variation is expected in the base working population which could be attributed to the Spaceport missions. There would be no change in the number of persons residing in base housing. Impacts to Vandenberg land use would be approximately the same for all of the three viable alternatives.

Presently, the Spaceport project employs approximately 40 local personnel working to develop plans and documentation. Construction of the facilities would involve as many as 100 construction personnel over a period of at least 18 months. As construction is completed, the 40 individuals working to develop the Spaceport would be employed in the operational phase of the project to perform systems level and integration tasks associated with the operations of the Spaceport.

In addition to the 40 personnel, an operations and maintenance crew of approximately 20-25 personnel would be required to ensure that the new facilities were properly maintained at the Spaceport. This crew would be augmented by subcontract labor on a regular basis depending upon the length and complexity of customer launch operations. Some customers would prefer to perform vehicle and facility processing tasks without much support from Spaceport operators. Others would require substantial support, especially in facility operations.

Companies with commercial launch capabilities at Vandenberg would require some level of manning for operations at the Spaceport. The Spaceport provides temporary facilities for users. A standard launch operation would require 50 personnel including management, integration, operations, security, safety, and other important personnel. There are two Stack and Checkout Facilities capable of supporting a launch operation so up to 100 customer personnel would be present for the majority of the time. Some potential customers of the Spaceport have indicated that a large portion of the crew required to process and launch a vehicle would be temporarily relocated from factory sites for the launch operations. Others have indicated that a resident crew of personnel would be maintained at Vandenberg AFB or the surrounding area and augmented as necessary to handle increased launch rates. A conservative estimate of direct, permanent employees supporting the California Spaceport operation on South Vandenberg AFB would be 60 employees employed by the operating contractor or its subcontractors, and another 100 personnel from customer sources. If each potential customer organization and supporting businesses, many of which are also military contractors on the base, requires a permanent manning level of ten individuals to support their predicted commercial launch rates, an additional 70-80 employees would be required. Some companies would require more personnel if they are not able to utilize launch crew members who are also used on military missions.

A further source of employment at Vandenberg AFB is the launch support tasking that results from a launch operation. Radar, telemetry, weather prediction, safety, security, supply and other critical tasks are required functions of any launch operation. Present Air Force and other government launch rates have steadily declined since 1985, and will continue to decline in the coming years due to decreased government funding for military space programs. Commercial launch operations would fund government and contractor jobs that might otherwise be lost due to these government reductions. While it is difficult to predict the number of jobs could be directly attributed to commercial launch support functions, with commercial launches making up the bulk of launches from Vandenberg in the coming years, it is not unreasonable to predict that up to 50 personnel in all areas of support would be attributable to commercial space activities. These individuals would support military launches as well, thus providing a direct return to the government in the form of a trained, augmented work force. The addition of these resources to military operations would directly enhance AIr Force operations.

Local businesses would also benefit from increased commercial space operations. Hotels, restaurants, and other support industries would provide jobs to the local communities. Expenditures of the proposed work force associated with Spacport launch operations of approximately 280 personnel would generate an estimated 114 indirect jobs based on a multiplier of 0.41 (USAF 1989a).

Table 4-1. Summary of Employment Data

| Employment Source | Positions |
|---|---|
| Construction (Temporary) | 100 |
| | |
| Direct Spaceport Operations | 160 |
| Launch Support | 50 |
| Spaceport Customer Organizations | 70 |
| Indirect Jobs | 114 |
| **Total Permanent Jobs** | 394 |

### 4.2.2 Western Santa Barbara County

The Spaceport program would not be expected to negatively influence the demography of Western Santa Barbara County. Potential socioeconomic effects would depend on the number of persons who move to the area for employment opportunities provided by the proposed project. An influx of people would increase the demands for housing, public service, and utilities. In general, these impacts are expected to be beneficial to the region surrounding VAFB. Employment benefits to Santa Barbara County are expected to be approximately the same for all three viable alternatives.

Launches from the proposed Spaceport would have less impact than other launch programs currently operating at Vandenberg AFB, such as Titan IV at SLC-4 and Atlas at SLC-3. Launches at the SLF would also have a comparatively small impact relative to other rocket launching programs considered at SLC-6 or SLC-7 (USAF 1983, Environmental Solutions 1990a). Even though Shuttle operations and Titan IV operations were curtailed before launches could take place, vast amounts of data and innumerable studies were conducted to determine potential impacts. Since on-going launch operations from SLC-4 and SLC-3, and potential launches of the Titan IV/Centaur and the Space Shuttle were considered to represent insignificant impacts to populated areas of western Santa Barbara County, it is expected that launches at the SLF would also involve insignificant impacts. Spaceport operations would create approximately 400 jobs for the Central Coast of California during a period of considerable down-sizing of Air Force operations at the base. Details of exhaust products and noise from a typical rocket launch are discussed in Sections 4.3.1 and 4.5.3, respectively.

### 4.2.3 Recreation

The preferred alternative site for the construction of the SLF would utilize an already industrialized setting at SLC-6. Under the preferred alternative and the SLC-5 North alternative the construction of the new Spaceport Launch Facility would not affect the visual resources at Jalama Beach. Although construction at the Cypress Ridge alternative location would have visual impacts to the Jalama recreation area, they would be of a comparatively minor nature since the SLF would be small in size. Each of the SCFs would be only 160 ft tall.

Rocket launches at the SLF would be in accordance with the required ground, range, and flight safety regulations of the Air Force at Vandenberg AFB. Normally, the public is restricted from access to South Vandenberg, Point Arguello, and the Boathouse Area. During launches at the SLF, the 30 Space Wing Safety Officer would direct the clearing and closing of these areas. This would be enforced by helicopter patrols (MSgt. Mercier, VAFB Game Warden, personal communication, October 1994). The patrols would be intermittent, of short duration and would fly between 300 feet and 1000 feet above the ground. Helicopter flights would be offset at least 300 yards, at altitudes of over 300 feet, from the harbor seal rookery near Rocky Point. There would be no use of ATVs. Therefore, these patrols would not impact nor affect nesting shorebirds and other wildlife.

The closure of beaches on VAFB would only be for as long as necessary to assure that the public is not endangered during the launch. Because of the low explosive content of the rockets launched from the SLF, less of the Vandenberg coastline would be closed than had been contemplated for the Space Shuttle or Titan IV/Centaur (1978, 1983, 1989a), or for on-going launch operations from SLC-4 and SLC-3. The coastline may be reopened within a short time after a launch. Advance notice of launches is expected as no classified payloads are currently contracted and potential programs have not indicated a need for secrecy of the launch schedule.

The maximum number of launches in a year is estimated at 24. Impacts from closure of the coastline and interruptions to marine recreation during launches at the SLF are not anticipated due to vehicle size and the launch trajectories. In particular, there would be no closure of the Jalama Beach area. Launches from the SLC-5 North alternative site would have more potential to close Jalama Beach than launches from either the preferred alternative site or from the Cypress Ridge alternative site.

### 4.2.4 No-Action Alternative

The No-Action alternative would result in no impacts to Vandenberg AFB land use. However, the government would not benefit from sharing the costs of Range infrastructure operation and maintenance with commercial users.

This alternative would result in no increased demand for housing, public services, and utilities. The No-Action alternative would also not allow the creation of approximately 400 jobs that could potentially be needed within Santa Barbara County to support operations at the Spaceport.

Visual impacts to Jalama Beach recreation area caused by the construction and operation of the Spaceport would not occur if this alternative is selected. The closure of beaches and recreational areas on Vandenberg AFB for safety purposes during launches from the Spaceport would not be required. Safety and security sweeps using helicopters and ATVs would also not be required.

## 4.3 Atmospheric Resources

Potential air quality impacts during construction of the SLF would result from fugitive dust related to earth moving operations. These effects would be minimized by onsite watering and design constraints.

Emissions from Spaceport construction would not significantly impact ambient air quality. Emissions from payloads during ground processing are contained within closed propellant servicing systems. Payload propellant systems are not used until the spacecraft has achieved orbit, thereby avoiding upper atmospheric impacts. An analysis of construction air emissions for ozone precursors relative to Clean Air Act conformity and SBCAPCD thresholds has resulted in the conclusion that the proposed action is *de minimis* and exempt from further conformity determination (Appendix E).

The remainder of this section describes the potential impacts of rocket launches at the SLF. During these operations, there would be minor and infrequent emissions of fuel, oxidizer vapor and combustion products. However, rocket exhaust would be produced during every launch. Section 4.3.1 describes the exhaust products of typical rocket motors. Section 4.3.2 discusses the potential environmental impacts of the emissions.

The Spaceport Launch Facility would be capable of supporting the launch requirements of multiple commercial and government organizations. It is impractical to thoroughly document the launch effects of each of the potential launch vehicles. The discussions in this section will be based primarily on launches of the Lockheed Launch Vehicle (LLV) because modeling results indicate that the LLV family of vehicles represents the "worst case scenario" relative to atmospheric resources. The LLV is a family of three rocket vehicles that use the Castor 120$^{TM}$ as a first stage booster (USAF 1994). These are the LLV 1, the LLV 2 and the LLV 3. The LLV 3 is used as the representative vehicle for these discussions because it has the greatest emissions of the three Lockheed launch vehicles. The LLV 3 vehicle is based upon Thiokol's commercially available Castor 120$^{TM}$ space booster and Castor IV$^{TM}$ strap-on rocket motors. Additional discussions will be included for the LLV 1 and LLV 2, where appropriate. Potential impacts from other launch vehicles will also be incorporated where information is available.

### 4.3.1 Rocket Motor Exhaust

The Castor 120$^{TM}$ is a solid rocket motor, weighing a total of 116,100 pounds (propellant weight is 108,000 pounds), which burns for approximately 80 seconds. The Castor IV$^{TM}$ is also a solid rocket motor and is available in several variations known as the Castor IVA$^{TM}$, Castor IVB$^{TM}$, and Castor IVXL$^{TM}$. The primary difference in these variants is the amount of propellant used. Since the Castor IVXL$^{TM}$ (propellant weight - 26,000 lb) is the largest of these variants, discussions will use the Castor IVXL$^{TM}$ as the strap-on motor for the launch vehicles discussed. The launch vehicle would leave the launch stand at the SLF within one second of the start of the first stage rocket motor. The exhaust products are discussed here to assist in understanding the discussions relative to other natural resources.

#### 4.3.1.1 Exhaust Products of the Castor 120$^{TM}$ and Castor IV$^{TM}$

The Castor 120$^{TM}$ motor is a solid fueled rocket engine. It burns at a rate of 620 kg (1,367 lb) of fuel per second, for approximately 80 seconds. The Castor IV XL$^{TM}$ uses 192 kg (424 lb) of fuel per second, and burns for approximately 60 seconds. The LLV 1 would require approximately 11.4 seconds to reach an altitude of 914 m (3,000 ft). The time required for the LLV 2 and the LLV 3 to reach the same altitude is 18.4 seconds and 16.5 seconds, respectively.

The chemical composition of the exhaust is relatively constant throughout the period that the rocket is firing. This results from a standard fuel mixture contained in a preset rocket design. The chemistry of solid rocket motor propellant is the single most important factor in determining the performance, safety, reproducibility, and cost of a solid rocket propulsion system. All space launch vehicles incorporating solid rocket motor technology today use a rubber binder containing aluminum as the primary fuel, and ammonium perchlorate (AP) as the oxidizer. This formulation offers an excellent combination of safety and economics, with negligible environmental impacts.

The primary constituents of the rocket exhaust are listed in Table 4-2. The dispersion of these compounds into the lower atmosphere is discussed in Section 4.3.1.3. Results of Rocket Exhaust Effluent Diffusion Model (REEDM) model analysis indicate that compositions of the exhaust plume would not pose a hazard to humans or to wildlife. The exhaust plume would be present for approximately 40 minutes after each launch. There would be no cumulative impacts to air quality due to the dispersive qualities of the atmosphere.

Table 4-2. Exhaust emissions to 914 m (3,000 ft) elevation[1]

| Launch Vehicle | Carbon Dioxide ($CO_2$) | Carbon Monoxide (CO) | Hydrogen Chloride (HCl) | Aluminum Oxide ($Al_2O_3$) |
|---|---|---|---|---|
| LLV 1 | 301 (0.15) | 3,455 (1.73) | 2,782 (1.39) | 5,217 (2.61) |
| LLV 2 | 485 (0.24) | 5,576 (2.79) | 4,490 (2.25) | 8,421 (4.22) |
| LLV 3 | 1,245 (0.63) | 14,307 (7.15) | 11,519 (5.76) | 21,605 (10.80) |

[1]Units are in pounds per launch (tons per launch).

There are many other trace compounds in the exhaust plume that produce only a few pounds of material (Appendix D). In addition, small amounts of pure helium are released through the pressurization of the hydraulic thrust vector control system that guides the main booster nozzle.

During a ground abort or incident near the ground, the chemical composition of the burning rocket fuel is different. The amount of fuel consumed would depend on the type of incident and whether or not a fire occurs, and when it is quenched. If a booster is completely burned, approximately 15.5 percent of 49,000 kg (108,000 lb) would remain in either a liquid or solid form. The remaining 41,400 kg (91,280 lb) would become a gas or free particulate matter.

The LLV 3 includes two to six strap-on Castor IVA™/IV XL™ solid rocket boosters which use the same solid propellant as the Castor 120™. The Castor IVA™ contains approximately 10,433 kg (23,000 lb) of fuel which is burned at the rate of 174 kg (424 lb) per second during a nominal launch. The Castor IV XL™ contains approximately 11,790 kg (26,000 lb) of fuel which burns at the rate of 192 kg (424 lb) per second. For the case where six Castor IVA™/IV XL™ are strapped onto the launch vehicle, an additional 1044 kg (2,544 lb) of exhaust per second would be discharged along with the main Castor 120™ booster's discharge of 620 kg (1,367 lb). The distribution of chemical species in the total exhaust of the LLV 3 at launch remains the same.

The LLV 3 behavior in an abort on the ground or near the ground is the same as the case discussed above for LLV 2. The fuel in the Castor IVA™/IVXL™ would burn in the open atmosphere as described above for the LLV 2, only the amount of potential remaining fuel to be consumed by a fire would change.

#### 4.3.1.2 Products of the Attitude Control System

The Attitude Control System (ACS) is used to roll the rocket and make fine corrections to maintain the proper course. The system consists of four very small rocket engines, called thrusters, which fire intermittently as required by the navigation systems. The thruster system uses hydrazine ($N_2H_4$) as fuel. The products of the reaction which provides the thrust are listed below (Table 4-3).

The ACS would begin to operate after the rocket has climbed approximately 305 m (1,000 ft) above the SLF. When operating at maximum thrust, the ACS converts 0.23 kg (0.5 lb) of hydrazine per second into exhaust products (Table 4-3).

During a ground abort or incident near the ground, the chemical composition may be different if a fire occurs. Besides reduction to nitrogen, hydrogen, and ammonia, oxides of nitrogen may also be expected to form.

Table 4-3. Attitude Control System Chemical Reaction Products

| Chemical | Mass Fraction |
|---|---|
| $N_2$ | 0.581 |
| $H_2$ | 0.065 |
| $NH_3$ | 0.354 |

**4.3.1.3 Dispersion of the Rocket Exhaust After Launch**

The exhaust plume that forms during the launch would drift downwind and disperse. The dispersion is influenced by the stability of the atmosphere at the time of launch. Using the LLV 2 as a representative vehicle for discussion, the Air Force REEDM model has been applied to identify the hazardous or toxic potential of the exhaust plume (Nyman 1993). The objectives of this toxic hazards assessment were to estimate, via the REEDM model, the location and concentration of airborne chemical vapors produced as the result of normal launch operations and plausible accident scenarios (Nyman 1993). This was done by assuming a variety of meteorological conditions which might occur at South Vandenberg and chemical releases that are representative of the LLV 2. "Best case", "worst case" and average atmospheric conditions were considered. In addition, both normal and aborted launch scenarios were considered.

The outputs were referenced to several guidelines for exposures of toxic chemicals: the Recommended Exposure Limit (REL), the Permissible Exposure Limit (PEL), the Threshold Limit Value (TLV), and the Short-term Public Emergency Guidelines (SPEGL).

Results from the normal launch scenarios indicate that the instantaneous atmospheric concentrations of HCl could range from 1.1 ppm to 8.2 ppm (Nyman 1993). Corresponding peak 30 minute average HCl concentrations could range from 0.02 to 0.30 ppm. The distance to these peak levels would range from 2.0 km (0.6 mi) to 12.0 km (7.5 mi) downrange.

Air dispersion modeling also predicted atmospheric levels of aluminum oxide ($Al_2O_3$) for normal launches of an LLV 2 (Nyman 1993). The distance to the maximum depositions of $Al_2O_3$, less than 6850 particles per $m^2$, would range from 3.0 km (1.9 mi) to 6.0 km (3.7 mi). These particles would pose no health risk, as they would be mostly greater than 10 microns in diameter.

Under typical meteorological conditions, the REEDM indicates that hydrogen chloride (HCl) concentrations of 5 parts per million for one minute are expected to occasionally trigger the current launch hold criteria. This reflects a recent, more restrictive change in the maximum allowable limits for HCl recommended by the Air Force Armstrong Laboratory. Vandenberg AFB has implemented the Armstrong Laboratory recommendations. The unavoidable consequence of this is greater likelihood of launch holds.

The maximum HCl concentrations from launches of the LLV 2, or other launch vehicles from the SLF, would be less than for launches of the Titan III (Pellett et al. 1983). The maximum HCl levels measured during Titan III launches at Cape Canaveral ranged from 10 ppm to 25 ppm.

When the Air Force was considering using solid rocket motors for its Titan program, a diffusion analysis was presented for the Titan IIIC and Titan IIID programs in the Final Environmental Statement (FES) for US Air Force Space Launch Vehicles. In the 1975 FES, profiles of peak ground level concentrations of HCl were represented as a function of distance from the launch pad area. These profiles were conducted using typical weather parameters and expected performance and trajectories of the vehicles. Peak ground level concentrations of HCl were predicted to be 11 ppm at a distance of approximately five kilometers downwind from the launch pad for a Titan IIIC/D launch. The peak concentrations would be present for only 2 to 15 minutes in any location depending on wind conditions.

The Titan 34D7 program and its environmental impacts were described in the Environmental Assessment for Complementary Expendable Launch Vehicle at Cape Canaveral Air Force Station in 1986. The diffusion model for the ground cloud was based on the 1975 FES. Peak ground level concentrations for a Titan 34D7 launch were estimated by prorating the predicted peak ground level concentration for Titan IIIC/D launches using the ratio of SRM propellant quantities as a multiplier. Peak ground level concentrations of HCl were predicted to be 18 ppm.

A very conservative estimate of ground level concentrations of HCl can be found for a Spaceport launch of an LLV 3(6) employing the same method of prorating the predicted peak ground level concentration for Titan IIIC/D launches using the ratio of SRM propellant quantities as a multiplier. The Titan IIIC/D used 870,000 pounds of solid rocket motor propellant, while an LLV 3(6) uses only 264,000 pounds of the same type of fuel. This leads to a ration of 3.3:1. Using this ratio, a plot was made showing the peak concentration of HCl to be 3.65 ppm five kilometers from the launch pad. This plot is shown in Figure 4.1. This small concentration would grossly over-estimate the actual concentration to be expected for the following reasons:

- The vertical variation in the concentration of the HCl would be affected by the fact that the LLV 3 is a lighter, faster rocket that would attain the mixing altitude long before the Titan IIID or 34D7, thus reducing the concentrations of HCl.

- Ground cloud measurements for HCl concentrations for a Titan IIID launch at Vandenberg, and at United Technologies Corporation during a test firing of a seven segment SRM have yielded data that were approximately half of the levels predicted by the diffusion model.

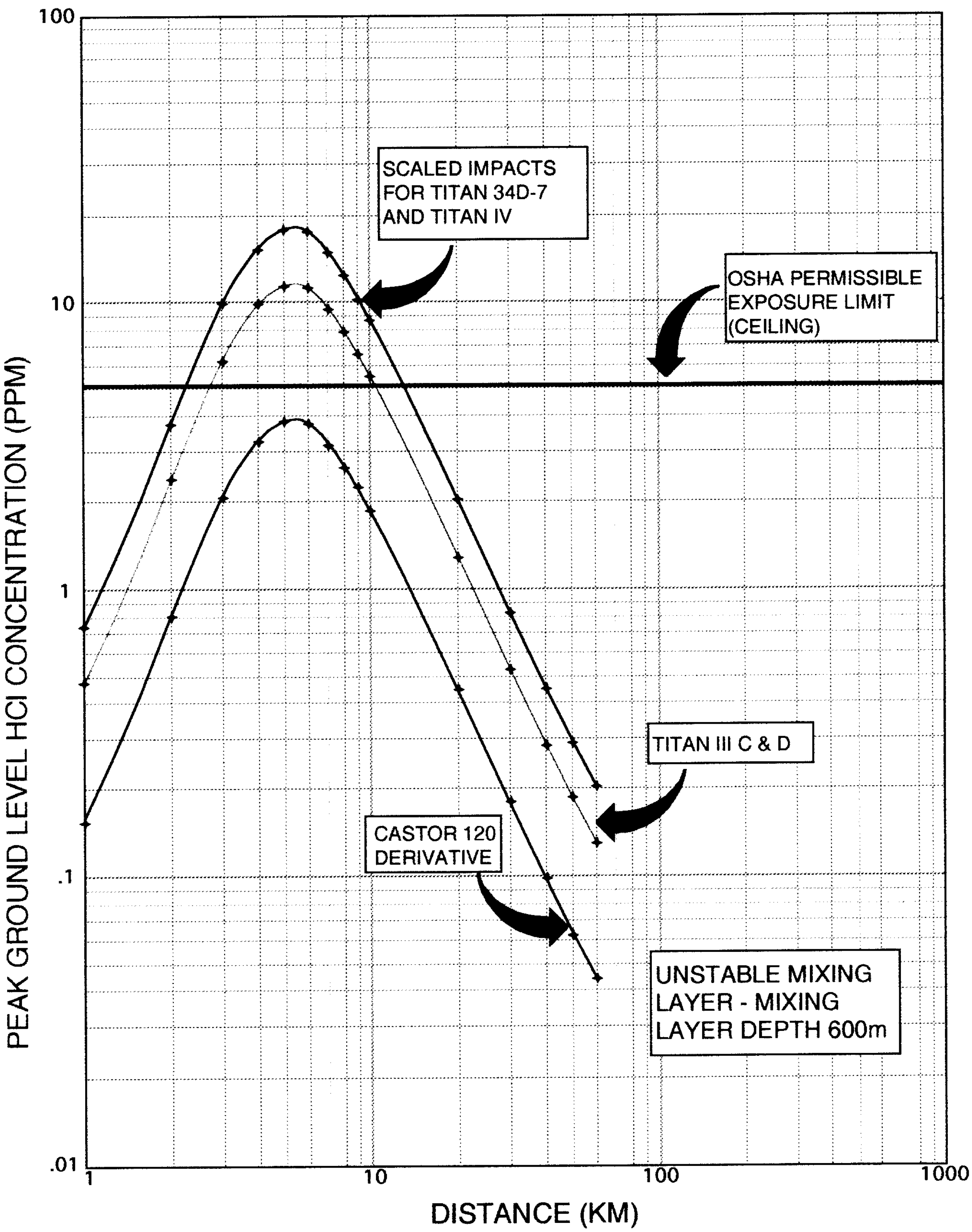



Figure 4.1. Predicted Ground Level HCl Concentration Profile as a Function of Distance From the Launch Site

Even if the less quantifiable vertical variations in the ground cloud concentration due to the difference in weight of the rocket and payload between the Titan and LLV vehicles are ignored, the concentration of HCl possible at the biologically sensitive Honda Creek, approximately 2.3 miles north of the preferred alternative launch site, from a Spaceport launch is approximately 1.85 parts per million under ideal conditions, assuming the largest vehicle to be launched from the Spaceport. When it is further understood that the ideal weather conditions for such deposition are only statistically probable 10% of the time due to the prevailing winds at Vandenberg AFB, it is clear that the potential for damage to Honda Creek natural resources does not warrant further study, or mitigation. Finally, it must be realized that this analysis makes use of the LLV 3(6) to characterize all 24 launches that make up the maximum anticipated launch rate to provide an extreme worst-case analysis. In practice, the manifest will be comprised of a mix of large and small vehicles. The smaller vehicles would be even less likely to have impacts associated with HCl ground clouds.

The azimuth of the rocket exhaust plume, under typical weather conditions, would range from $153^{o}$ to $186^{o}$ and the plume width would be less than 2.8 km (1.6 mi). The total duration of this event would be less than 40 minutes (Nyman 1993). The localized and transient nature of the exhaust plume and its location over ocean water would not present a significant hazard to the population centers or recreation areas. With respect to these air quality issues, rocket launches would be conducted in accordance with safety zones and safety regulations established by Vandenberg AFB.

In the event of an aborted launch, the 3 ppm 30 minute time weighted average HCl concentration would not be expected to be exceeded under any weather conditions. The 1 ppm HCl SPEGL would likely to be exceeded under all weather conditions, including those most favorable to rapid dispersion. Instantaneous peak HCl concentrations as high as 33 ppm, at a point 2 km (1.25 mi) downwind from the pad, would be predicted as a reasonable worst case for an explosion on the launch pad.

Regardless of the preliminary predictions accomplished to date, if the 30 SW Safety Office determines that analysis of toxic plumes is required on launch day, these analyses would be accomplished. If the launch day analyses indicate violation of allowable concentrations of toxic materials in the vicinity of public areas, the launch would be held until favorable atmospheric conditions are present.

#### 4.3.1.4 Fugitive Hazardous/Toxic Material

Fugitive solid rocket fuel is not anticipated during normal rocket launches. In the event of an aborted launch, the rocket propellants would be converted to combustion products. These products and their potential impacts are discussed in the next section of this document.

Fugitive hydrazine may occur during connection and disconnection of the supply line at the Hypergolic Storage Facility (HSF) and the hydrazine service cart, or between the hydrazine service cart and the storage bottles in the attitude control section of the launch vehicle. The HSSF is subject to Permit to Operate (PTO) 7987, issued September 28, 1992. As such, VAFB has a comprehensive inspection and maintenance plan to prevent fugitive emissions.

Activities related to the Spaceport would rely on existing hydrazine transfer equipment to the maximum extent possible. Spaceport operators would assist customers in obtaining the use of existing, approved loading carts, if necessary. User-provided carts would be subject to the same emissions requirements as existing carts. Vandenberg AFB retains control of all hydrazine movements and transfers. The Spaceport would abide by all VAFB requirements in this regard. It is expected that hydrazine emissions associated with fuel transfer operations would be negligible and within *de minimis* limits.

In addition to liquid-free cleaning methods, small amounts of isopropyl alcohol (IPA) would be used to clean the rocket shrouds for launches of dust-sensitive payloads. The wipe rags would be stored in sealed containers and disposed of properly. The handling of solvents, waste rags, and used containers would be in accordance with the regulations of Vandenberg AFB and its agreements with state and Federal regulators. This use of IPA would result in atmospheric emissions of less than 0.1 pound per hour.

### 4.3.2 Potential Impacts to Air Quality

#### 4.3.2.1 Impacts from Accidental Open Burn of Rocket Fuel

The first and second stage solid rocket motors would be received with a canvas cover placed over the nozzle. There would be no internal maintenance on the motors at the SLF. Only in the event of an accident involving the handling of the motor would there be solid fuel exposed to the environment. To guard against this, adequate fire protection and prevention measures would be implemented, as required by the Air Force.

The likelihood of accidental ignition of rocket fuel or an aborted launch would be very low. Since the reliability of each major component is near unity, the combined failure rate for the complete missile system would be very low. Experience to date has been 27 successful firings of the Castor 120™ type boosters without a failure. Through February, 1992, over 1,862 Castor motors of various types have flown, with a success rate of 99.95%.

Paragraph 4.3.1.1 discussed the constituents of the Castor 120™ motor fuel when it burns in the open atmosphere. The solid fuel would not spontaneously ignite in the atmosphere. Open burning of all the fuel in the booster would release 6,434 kg (14,185 lb) of aluminum oxide ($Al_2O_3$). However, this would primarily occur in a slag-like form that would not effect the atmosphere. The impact on air quality of the open burning of the rocket fuel is discussed below.

The Castor 120™ is a commercial derivative of the first stage motor of the Peacekeeper intercontinental ballistic missile. Analysis of the Peacekeeper first stage, recently used to launch a Taurus rocket from a North Vandenberg AFB launch site (576E) has indicated a probability of detonation of between $2.78 \times 10^{-4}$ and $1.84 \times 10^{-6}$, depending on failure mode and analysis methodology involved. Taurus launch vehicles are similar to the Lockheed Launch Vehicle that is analyzed throughout this document. Flight test history of the Peacekeeper bears out these probabilities as 26 successful flights and no failures of the Peacekeeper vehicle clearly shows. Regarding an inadvertent or deliberate destruct on or near the launch pad, explosive flight termination systems are designed such that they fragment the booster case and grain in such a way that no detonation is possible, and in fact, most of the propellant would not even burn. Hence, emissions would be less than for a normal launch. Therefore, impacts from launch failures are not considered a credible event, nor are they significantly different from a normal launch.

If one complete solid rocket booster, Castor 120™, burns in the atmosphere at standard atmospheric pressure, the primary products would include carbon monoxide (CO), carbon dioxide ($CO_2$), nitric oxide (NO) and hydrogen chloride (HCl). Table 4-4 summarizes the results of a complete burn of 49,033 kg (108,100 lb) of propellant. The products of combustion are in different ratios than those resulting from a normally operating launch vehicle.

Table 4-4. Predicted Products from Open Burn of a Castor 120™

| Combustion Products | Quantity | |
|---|---|---|
| | Kilograms | Pounds |
| $CO_2$ | 3523 | 7768 |
| HCl | 3205 | 7065 |
| CO | 2720 | 5997 |
| NO | 550 | 1212 |

The release of HCl would be at a much lower level than if the rocket were operating normally. The HCl would combine with moisture in the air to the extent that moisture is available. This combining action results in hydrochloric acid. The vapor may exist in hazardous concentrations in the immediate downwind region of the fire. Dissipation to concentrations that are not immediately hazardous would result quickly if the wind is greater than 6.5 km per hour (4.0 miles per hour) or if there is strong sunshine. The HCl would eventually wash out of the atmosphere with rain.

Under the assumption of a 10-minute fire that consumes an entire booster motor containing 49,033 kg (108,100 lb) of fuel, 550 kg (1212 lb) of nitric oxide (NO) would be released. Nitric oxide degrades air quality as it is a contributor to smog and ozone generation. The NO would be released as a gas into the atmosphere.

Oxygen ($O_2$) and nitrogen ($N_2$) would be released if the solid fuel of the main booster burns. Both of these gases exist generally as common molecules in the atmosphere. The atmosphere is 21 percent oxygen and 78 percent nitrogen. The release of $O_2$ and $N_2$ from a fire consuming solid rocket fuel would be lost in the atmosphere almost immediately.

**4.3.2.2 Freon Systems**

There would be no planned releases of fluorocarbons to the atmosphere. Ozone depleting chlorofluorocarbons (CFCs) and hydrofluorocarbons (HFCs) are commonly used for both cooling systems and fire suppression systems. Support services for payloads may require provision of a cooling system for the period immediately before launch. An electromechanical compressor/ condenser unit would be used. There would be no planned free venting of the system to the atmosphere. The Spaceport would comply with all U.S. Air Force policies and instructions, and the Montreal protocol, that apply to the use of ozone depleting chemicals.

**4.3.3 Stationary Sources**

The Spaceport program would not expect to use internal combustion engine driven stationary equipment. No releases of potential pollutants would be anticipated for this category of sources. Paints, solvents, adhesives, etc. would be used for maintenance activities in quantities of less than ten gallons per year, and in accordance with APCD rules and regulations. Spaceport customers would also use these types of commodities in small amounts. Individual users would identify required quantities in separate environmental analysis documents. Diesel powered back-up generators would be used in case of a commercial power interruption at the launch site. These are exempt from permit pursuant to Santa Barabara County APCD rules 202.C.2.e. Critical power circuits would be connected to an uninterruptable power system (batteries or fuel cells) that would maintain a stable power source for critical equipment while the emergency generator comes on line. When commercial power is restored, the emergency power generators would be turned off. The total operating time for maintenance and emergency use of these generators would be less than 200 hours per year. Sources operated less than 200 hours per year are exempt. Using these precautionary measures, atmospheric emissions from stationary sources would be within *de minimis* levels and exempt from permit.

### 4.3.4 Mobile Sources

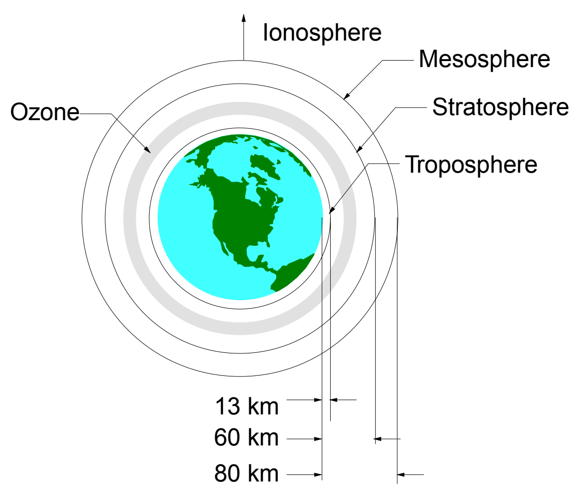
During construction, mobile sources would include commuter vehicles for transportation of construction workers. Following construction, commuter vehicles would transport Spaceport employees and customer personnel to and from the launch site. Additional vehicles would transport payloads and launch vehicles. Emissions from these mobile sources have been calculated for the Clean Air Act Conformity analysis and are described in Section 4.3.6.

All mobile sources would be equipped with pollution abatement systems and operated in accordance with the requirements of the State of California. Most of the rocket assembly would be performed within the SCFs. Material handling equipment would conform to the requirements of the State of California.

### 4.3.5 Upper Atmosphere

Potential contributions to the upper atmosphere include materials and activities on the ground as well as the flight of the launch vehicle. The Spaceport would cause no major pollution producing ground activities, other than the production of exhaust products during a launch, which would affect the upper atmosphere. The program would have ground support systems which use fluorocarbons (CFCs or HFCs) in closed systems.

The various atmospheric zones surrounding the earth are depicted in Figure 4.2.




Source: *Environmental Impacts from Launching Chemical Rockets*, A.J. McDonald and R. R. Bennet, Thiokol Corp.

Figure 4.2. Stratospheric Ozone Effects

Of particular importance to the environment is the stratosphere, located 13 km (8.1 mi.) to 50 km (31.1 mi.) above the earth. The stratosphere contains a low concentration of ozone ($O_3$) that acts as a protective shield from damaging ultraviolet radiation from the sun. Figure 4.3 shows chemical and photochemical processes that are important in the formation of the ozone from molecular oxygen in the stratosphere and the reactions associated with ozone destruction. The process is very dynamic in that ozone is continuously being produced and destroyed by naturally occurring photochemical processes in the stratosphere. Figure 4.4 summarizes the naturally occurring ozone-depleting chemistries into nitrogen, hydrogen, oxygen and chlorine.

**Ozone Production**

$$O_2 \longrightarrow 2O$$
$$O + O_2 + M \longrightarrow O_3 + M$$

**Ozone Destruction**

$$O_3 \longrightarrow O + O_2$$
$$O_3 + O \longrightarrow 2O_2$$
$$Cl + O_3 \longrightarrow ClO + O_2$$
$$ClO + O \longrightarrow Cl + O_2$$
$$H + O_3 \longrightarrow HO + O_2$$
$$HO + O \longrightarrow H + O_2$$
$$OH + O_3 \longrightarrow HO_2 + O_2$$
$$O + HO_2 \longrightarrow OH + O_2$$
$$NO + O_3 \longrightarrow NO_2 + O_2$$
$$NO_2 + O \longrightarrow NO + O_2$$
$$Br + O_3 \longrightarrow BrO + O_2$$
$$BrO + O \longrightarrow Br + O_2$$

Source: *Environmental Impacts from Launching Chemical Rockets*, A.J. McDonald and R. R. Bennet, Thiokol Corp.

Figure 4.3. Natural Stratospheric Ozone Pathways

| | 25 to 30 km Altitude % | Total Stratosphere % |
|---|---|---|
| Nitrogen<br>$NO + O_3 \rightarrow NO_2 + O_2$<br>$NO_2 + O \rightarrow NO + O_2$ | 70 | 32 |
| Hydrogen<br>$OH + O_3 \rightarrow HO_2 + O_2$<br>$O + HO_2 \rightarrow OH + O_2$ | 10 | 26 |
| Oxygen<br>$O + O_3 \rightarrow 2O_2$ | 10 | 23 |
| Chlorine<br>$Cl + O_3 \rightarrow ClO + O_2$<br>$ClO + O \rightarrow Cl + O_2$ | 10 | 19 |

Source: *Environmental Impacts from Launching Chemical Rockets*, A.J. McDonald and R. R. Bennet, Thiokol Corp.

Figure 4.4. Relative Importance of Various Catalytic Stratospheric Ozone Depletion Cycles

It is important to note that all are catalytic cycles in that the ozone-depleting species is re-generated such that it can re-enter the cycle to destroy additional ozone molecules. Chlorine chemistry is responsible for the least amount of ozone destruction. The reason chlorine chemistry has been of the most concern is that it is the one that human activity has contributed to most.

Recent data obtained from aircraft flying in the lower part of the stratosphere has cast some doubt on the predominance of nitrogen oxide reactions to ozone destruction in the lower stratosphere. In the spring of 1993, instrumented aircraft observed all important families of radicals that affect ozone (chlorine, bromine, nitrogen, and hydrogen). Data indicated that the hydrogen radical may be a more important natural loss process for ozone than the nitrogen oxide cycles. These conclusions were also supported by more recent computer models that include heterogeneous chemistry. Previously used models based on homogeneous chemistry alone predicted that nitrogen oxides were the predominant ozone destruction mechanism.

Much of the environmental concern with rocket propulsion chemistry was a result of associating solid rocket-produced HCl with chloroflourocarbons (CFCs). Figure 4.5 presents a schematic representation of the CFC problem.

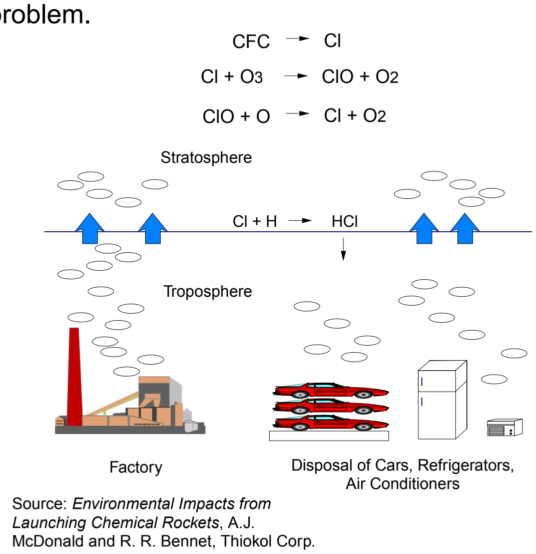



Figure 4.5. Effects of CFCs on Ozone

CFCs are very chemically stable compounds used in refrigeration, air conditioning systems, aerosol products and many cleaning solvents. These compounds are man-made chemicals that were designed to be chemically inert. Therefore, there are no natural processes in the troposphere to break down these chemicals until they reach the stratosphere. Photolysis by ultraviolet radiation releases chlorine atoms from the CFCs which enters into a catalytic ozone destruction cycle. Unlike HCl, which is washed out and removed as the stratospheric air circulates into the troposphere, CFCs are inert to most chemical processes in the troposphere. It is interesting to note that the chlorine released in the stratosphere from CFCs is eventually removed by a reaction of chlorine with stratospheric methane to form HCl, which can circulate to the troposphere and be removed. As can be seen from Figure 4.5 **the formation of HCl is the primary removal process for chlorine atoms released from CFCs in the stratosphere**. Although HCl generally acts as a sink for Cl in the atmosphere, in the presence of stratospheric ice crystals, stratospheric chlorine nitrate ($ClONO_2$), and $Cl_2$, HCl under photolysis reacts, produces $Cl_2$ at a rapid rate, and/or produces hypochlorous acid (HOCl) which is subsequently converted to Cl and ClO. Virtually all CFCs released into the atmosphere will eventually make it into the stratosphere, and remain there until chlorine is released by photodissociation. The chlorine atoms will catalytically destroy ozone until the chlorine is tied up in a reservoir specie, or can be removed by forming HCl. On the other hand, HCl deposited directly into the stratosphere from rockets must undergo a chemical reaction before the chlorine atoms can be released. Since HCl is not subject to photodissociation, some of the HCl deposited directly into the stratosphere may never release any chlorine atoms before it has a chance to circulate into the troposphere where it is readily rained out. Furthermore, HCl naturally occurs in the earth's atmosphere, with a large natural reservoir of HCl in the troposphere and stratosphere in contrast to the unnatural molecules of CFCs that were engineered by man.

As shown in Figure 4.6, of all the sources causing chemical removal of stratospheric ozone, rockets supply a very small amount of ozone depleting chemicals. Figure 4.7 shows sources of atmospheric HCl other than rockets.

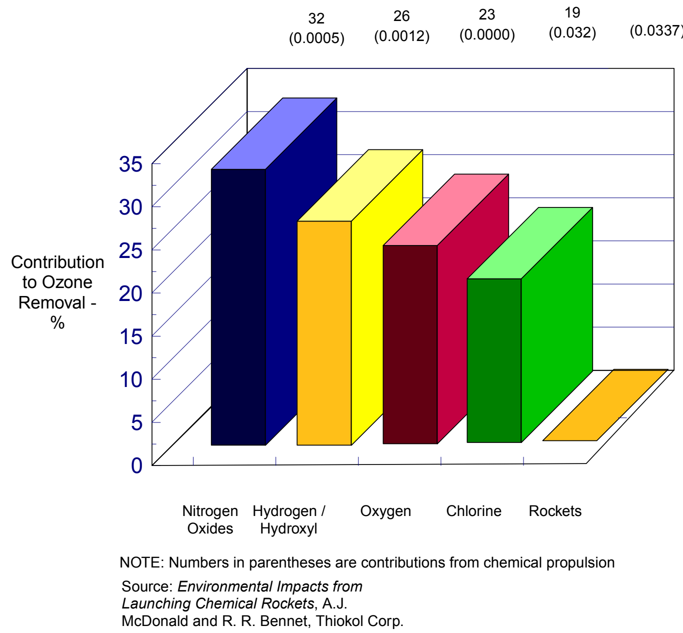



Figure 4.6. Chemical Removal of Stratospheric Ozone

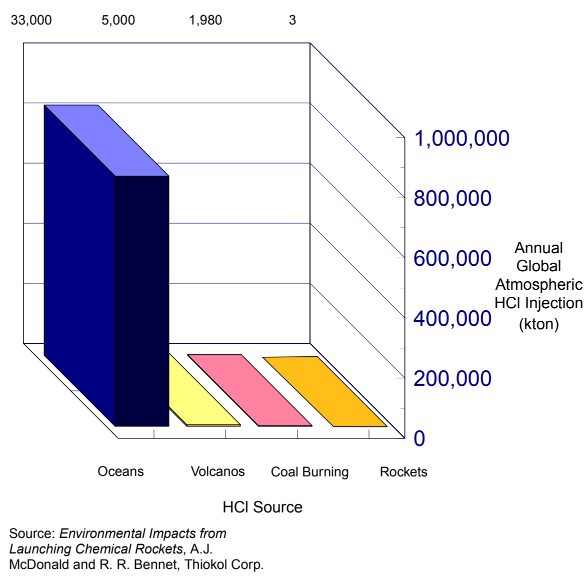
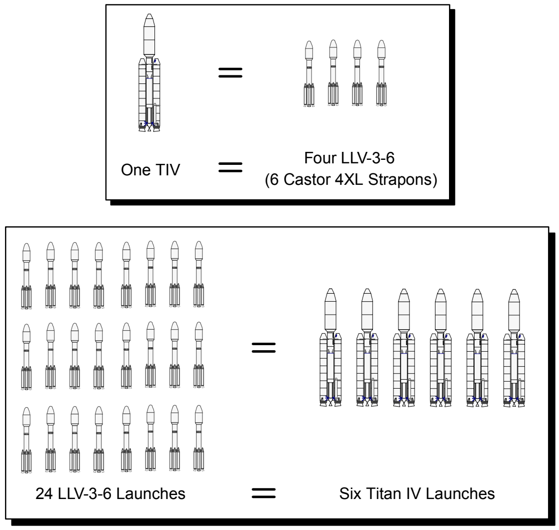



Figure 4.7. Global HCl Releases

Rockets contribute insignificant amounts of HCl to the atmosphere when compared with natural sources such as the oceans (330,000 kilotons), volcanoes (5,000 kilotons), and man-made sources such as coal burning processes (1,980 kilotons). It is estimated that launching nine Space Shuttles and six Titan IVs each year from Kennedy Space Center (KSC) in Florida would introduce the same amount of HCl into the troposphere as is produced by a 30 mile square area of the Atlantic Ocean just east of KSC. Launches from the Spaceport, assuming the extreme worst case of launching 24 of the largest rockets (LLV 3(6)) per year, would introduce the same amount of HCl as is produced by a 10 mile square area of the Pacific Ocean immediately to the west of Vandenberg AFB. Furthermore, as graphically depicted in Figure 4.8, the launch of one Titan IV produces the same amount of pollutants from solid rocket motor exhaust as four LLV 3(6) launches. Conversely, the solid rocket motors from the full Spaceport manifest launch of 24 LLV 3(6)s would produce the same amount of pollutants of only six Titan IVs.




| Pollutant | Titan IV Total Emissions for Complete Burn (tons) | LLV-3-6 Total Emissions for Complete Burn (tons) |
|---|---|---|
| $AL_2O_3$ | 244 | 62 |
| HCl | 146 | 34 |

Figure 4.8. Comparison of Solid Rocket Motor Pollutants

As a measurement of the greenhouse gas emission activity of chlorine, an estimated 20 million metric tons (22 million tons) of carbon equivalents of HFCs are released each year (Clinton and Gore 1993). This number does not include chlorine produced in other forms for water purification, bleaches, and intermediate chemical processes. As shown in Table 4-5, the 30.06 metric tons (33.14 tons) of HCl released by a launch of an LLV 3 is an insignificant contribution to the world climate discussion.

The aluminum oxide ($Al_2O_3$) creates the visible plume as the launch vehicle rises from the launch pad. The LLV 3 would produce 64.12 metric tons (70.68 tons) of $Al_2O_3$ during a launch (see Table 4-5). Approximately 8 percent of the earth's crust is composed of aluminum compounds, such as oxides and silicates. Furthermore, many pharmaceuticals, food additives, and health care products contain aluminum compounds. The insignificant amounts of aluminum oxide that would be deposited in the atmosphere by Spaceport launches would not create a health hazard. The aluminum oxide becomes a small particle which is heavier than air and would eventually settle out of the atmosphere or be washed out by rain in the lower atmosphere. Solid rockets consume less than 0.01 percent of the 69 billion pounds of aluminum metal produced each year in the United States.

The aluminum oxide can be compared to the fine particles of ash that are exhausted from volcanoes during eruptions. As a comparison to a volcano, such as the eruption of Mt Agung, Bali, in 1963 (Gates 1985), the product of a volcano dwarfs the output of a launch vehicle. In the case of the Mt Agung eruption, particles launched in the eruption could still be detected by photometers in Mauna Loa, Hawaii, in 1973. To the extent that there would be dust in the atmosphere from a Spaceport launch, the dust may contribute to heating of the atmosphere but the influence would be undetectable.

Table 4-5. Rocket Exhaust Per Launch of the LLV 3

| Constituent | Quantity | |
|---|---|---|
| | Metric tons | Tons |
| HCl | 30.06 | 33.14 |
| $CO_2$ | 3.25 | 3.58 |
| CO | 37.35 | 41.17 |
| $Al_2O_3$ | 64.12 | 70.68 |

**NOTE: Represents the total of exhaust products produced by the LLV 3(6) launch vehicle stage 1, stage 2, and strap-on boosters.**

Carbon, in the form of carbon monoxide and carbon dioxide, from the LLV 3 is a relatively small percentage of the total pollutant output of the rocket engine. The LLV 3's contribution to the atmospheric load of carbon products is insignificant when compared to the estimated total load of over 1,400 million metric tons (1543 million tons) produced each year (Clinton and Gore 1993). It has been postulated by several scientists that production of certain gases, such as carbon dioxide ($CO_2$), from the continued burning of fossil fuels could eventually cause more of the sun's energy to be trapped within the atmosphere, causing global warming. The amount of $CO_2$ produced by all chemical rockets is extremely minute, representing less than 0.00004 percent of the total anthropogenic sources of $CO_2$. For this reason, launches from the Spaceport, which would produce just a small fraction of the total $CO_2$ for all chemical rocket launches, would have an insignificant effect.

### 4.3.6 Clean Air Act Conformity

The Air Force and DOT are required to make a formal Conformity Analysis as to whether the proposed action, construction and operation of the new SLF, complies with the Conformity Rule of the Amended Clean Air Act (CAA) and SBCAPCD Rule 702. The conformity rule requires that total direct and indirect emissions of nonattainment criteria pollutants be considered. The rule does not apply to actions where these emissions would be less than *de minimis* levels, which is defined as 100 tons per year within a moderate nonattainment area. The complete conformity analysis is included in Appendix E and summarized in this section.

For this conformity analysis, emissions have been derived from Spaceport construction activities, gasoline and diesel fueled vehicles, diesel fueled power generators, and for launches of solid fueled rockets. Construction activities include site preparation, facilities construction, road and parking area surfacing, and rail access construction. Ground vehicles would be required for transportation of personnel, rocket motors, payloads, and support equipment. Generators would provide emergency power, if needed. The LLV 3 with six Castor IVXL motors was used to calculate launch effects, since it would produce the most emissions.

Initial construction activities would be limited to a period of 18 months. Site preparation and grading would begin in December and be completed in February. As a result, emissions from construction would only occur during the first phases of Spaceport operations. On an annual basis, these emissions would total 6.323 tons of ozone precursors (See Appendix E). This is well below the *de minimis* threshold level of 100 tons per year and would not be regionally significant.

The maximum launch rate from the Spaceport would increase to 24 per year by 1999. If each of these launches were assumed to be the LLV 3(6), the maximum annual emissions of ozone precursors would be 2.481 tons (See Appendix E). This is well below the *de minimis* threshold level of 100 tons per year.

### 4.3.7 No Action Alternative

The No-Action alternative would result in no impacts to atmospheric resources due to construction and operation of the Spaceport.

## 4.4 Land Resources

### 4.4.1 Soil Resources

Soils impacts would occur primarily during the construction of the SLF. Approximately 4.6 ha (11.4 ac) of soil surface would be lost to the launch pad and supporting facilities. Further losses would be minimized through erosion control measures. This would include watering the ground surface to prevent wind erosion and placement of stabilizing materials to prevent water erosion. Graded areas outside of the footprint would be revegetated with native plant species as soon as is practicable.

The exhaust plume from rocket launches may also impact soils. The class of launch vehicles supported by the Spaceport would be medium-sized and predominantly solid-fueled. These launch vehicles would produce exhaust clouds containing gaseous HCl.

Previous studies of the effect of launch-related HCl deposition on soils buffering capacity have focused primarily on HCl deposition from acid rain, which brings HCl directly into the soil system [Kennedy Space Shuttle EIS (NASA 1978, 1979), Schmalzer et al. 1993, Titan/Centaur EIS (USAF 1989a), Vandenberg Space Shuttle EIS (USAF 1983)]. Launch-related acid rain is created when sound suppression system deluge water evaporates during a launch, scavenges HCl gas from the rocket exhaust, and forms hydrochloric acid droplets. Because the Spaceport launch facility uses a dry launch duct (no deluge water sound suppression system), acid rain caused by the mixing of HCl gas and large amounts of deluge water would not be an issue for soils at the SLF. While acidic deposition for dry launches from the Spaceport would not produce the levels of acidic deposits associated with a wet launch system, the presence of coastal aerosols such as mists, fogs, or the marine layer could cause some molecular scavenging of water by HCl to occur. However, these and other coastal atmospheric mechanisms are also present at the Florida launch site, and it can be assumed that some level of molecular scavenging was in play during the studies cited.

For the most part, HCl clouds from Spaceport launches, unlike HCl clouds from wet launches, would have dry plumes with a propensity to rise. Very little work has been done on the actual atmospheric HCl input to soils from dry launches. One problem with modeling this interaction is that the deposition associated with gaseous clouds is difficult to quantify (P. Schmalzer, The Bionetics Corporation, Kennedy Space Center, November 1994).

Nevertheless, there is a possibility that nearby soils may receive some HCl from the exhaust plume during rocket launches at the Spaceport. Depending on the weather conditions, the instantaneous atmospheric concentrations of HCl could range from 1.1 ppm to 8.2 ppm (as compared with 10 ppm to 25 ppm for the Titan III). Corresponding peak 30 minute average HCl concentrations could range from 0.02 to 0.30 ppm. The atmospheric HCl inputs to the soils adjacent to the SLF would be less than the peak HCl levels that would be expected to occur downrange. The distance to these peak levels would range from 2.0 km (0.6 mi) to 12.0 km (7.5 mi) downrange (Nyman 1993).

How a soil responds to acid deposition (its buffering capacity) is primarily dependent on the cation exchange capacity (base saturation) of the specific soil in question (Brady 1974, Foth and Ellis 1988, Wild 1993). Buffering capacity is a function of the soil's organic matter and clay contents. A soil with a high base saturation (approximately 60 percent or greater) would require incorporation of a very large amount of an acid such as HCl to displace the cations and replace them with hydrogen, raising the soil's acidity and lowering its fertility. This is largely independent of the soil's pH.

Based on available data, the surface horizons of the soils near the SLF are high in both organic matter content and percent base saturation (base saturation is approximately 74 percent; see Appendix A and Section 3.5.2). Because the HCl expected from Spaceport launches would be airborne in relatively small quantities, and because of the soil's buffering capacity, HCl from Spaceport launches would be unlikely to modify the chemical properties of these soils.

This conclusion is supported by comparison with data from Space Shuttle launches at Kennedy Space Center, Florida. Soils at the Space Center are more susceptible to acidic deposition than those at SLC-6 (P. Schmalzer, The Bionetics Corporation, Kennedy Space Center, November 1994). However, despite additions of significant amounts of acidic deposition from 43 wet launches over a ten year period, the affected soils showed no decrease in buffering capacity (Schmalzer et al. 1993).

#### 4.4.2 Water Resources

Development of the Spaceport would require no new construction at the IPF, and only surface construction at the SLF. Local and regional water resources would not be affected since there would be no additional ground water withdrawals. Water utility piping would be run and used to meet miscellaneous onsite needs. As a result, there would be no related impacts to the ground water, surface water or wastewater processing systems.

Normal launches of vehicles would produce exhaust emissions as described in Section 4.3 above. In the event of launch vehicle accident, runoff and residue from the site would be contained, remediated, and disposed of in accordance with VAFB's Hazardous Materials Emergency Response Plan.

While the exhaust plume of solid rocket motors contain HCl, ground deposition of the HCl would not significantly alter the state of the local bodies of surface water. The water quality data indicate high total hardness with high levels of cations such as calcium, magnesium, and sodium (see Appendix B). In the event that rain water absorbs HCl which might then be deposited on the ground, this natural buffering capacity of the streams would result in negligible or no change in water quality.

At SLC-6, rain and wash water are collected into catchments that are tested before release. If the water in the catchment requires treatment, the water would be pumped to the industrial wastewater treatment facility for processing before release. Similar water catchment systems would be in place at the SLF.

#### 4.4.3 No-Action Alternative

The No-Action alternative would result in no impacts to land resources.

### 4.5 Biological Resources

Impacts to the biological resources would result from construction at the SLF, noise pollution, or from airborne compounds. Construction would affect the local vegetation and reduce the habitat available to some species of terrestrial wildlife. Grading and site preparation would begin in January and be completed by early March in order to avoid destruction of eggs or young of native wildlife during the breeding season.

Noise would be associated with 1) the early stages of launches, and 2) sonic booms produced as launch vehicles attain supersonic speeds (See Appendix F for a discussion of sound). Airborne compounds could result from near-field rocket exhaust, far-field exhaust clouds that settle back to earth, or from catastrophic combustion on or near the SLF. Each of these are discussed below according to their potential impacts on the local flora and fauna, including threatened and endangered species.

For the purposes of this EA an impact would be considered significant if it resulted in: (1) a reduction in the population size of a threatened or endangered species, or a species protected under the Marine Mammal Protection Act; (2) degradation of biologically important habitats that are either regionally rare or unusual, or are protected by County policy; (3) substantial long-term (10 years or longer) loss of vegetation or habitat degradation, to include noise and other disturbance within the region of influence of the Spaceport, which results in significantly reduced carrying capacity of habitat critical to threatened, endangered, or candidate species, or species protected under the Marine Mammal Protection Act; or, (4) substantial long-term reduction in wildlife populations.

Several species that are federally listed as threatened or endangered are found in the ROI of the SLF (See Table 3-4). These may be summarized as occurring in Cañada Honda Creek, Point Pedernales, Point Arguello, Rocky Point and Boathouse vicinity, and the southerly slopes of Cypress Ridge.

Up to 24 launches per year would occur at the SLF. During the first year of operation only 4 launches would be scheduled. After that, the annual launch rate would increase to a maximum of 24 by the year 2000. Environmental monitoring of vegetation, upland wildlife, listed species, seabirds and pinnipeds would be conducted to evaluate and predict the effects of rocket launches (Appendix G). Data would be collected primarily before and after each launch to determine the impacts of launch noise or exhaust plumes. This would provide important data relative to the environmental impacts that may result from launch activities on an individual basis, as well as potential cumulative impacts resulting from more frequent launches. Alternatively, mitigation may be performed to offset potential impacts.

All monitoring and mitigation results would be published in an annual Environmental Resources Document (Appendix G). This document would be available in March of each year.

### 4.5.1 Vegetation

#### 4.5.1.1 Spaceport Construction

The use of the IPF would involve indoor functions and activities at previously constructed facilities. There would be no new construction nor would there be expansion into undeveloped areas. Furthermore, the IPF is located in a protected, fenced area. Therefore, there would be no impacts to the natural vegetation or to wildlife from use of the IPF.

Less than 4.6 ha (11.4 ac) of vegetation would be disturbed by SLF construction. Impacts would be minimized by employing best construction practices. These would include trash containment, maximizing construction in previously disturbed land, imposing construction limits, and confining construction staging areas to disturbed areas devoid of coastal sage scrub or grassland habitat.

At the preferred alternative site, the majority of this construction disturbance would include coastal sage scrub vegetation. This loss would be mitigated by a 3:1 enhancement of disturbed coastal sage scrub vegetation at a suitable location selected by the Air Force. A restoration plan would be written where goals for successful restoration would be set. Restoration would not be considered complete until final goals have been met. Figure 4.9, Figure 4.10, and Figure 4.11 shows the vegetation in the construction area, identifies the project foot print, and indicates the construction limits for the project. Top soil removed during grading operations would be stockpiled and used to revegetate any temporarily disturbed construction areas. Erosion control measures would be used to prevent erosion in the cut and fill areas.

Storm Water Pollution Prevention Plan (SWPPP) has been written to identify storm water pollution control practices and procedures to be implemented for the Spaceport Launch Facility (SLF) to limit off-site sediment movement from project related demolition and construction activities (including clearing, grading, and excavation). The SWPPP has been developed to comply with the General Storm Water permit requirements, which were adopted by the State Water Resources Control Board on August 20, 1992. A noyice on Intent has been submitted to the State Board. Copies of the SWPPP would be provided to all project personnel who have day-to-day supervision of construction site operations.

Construction activities would temporarily increase the potential for soil erosion and the potential for sedimentation in some areas by removing vegetation and soil for building construction, trenching, pipeline placement, and related activities. The primary pollutant contained in storm water discharges from construction activities would be suspended sediments. Approximately 130,000 cubic yards of net fill would be required for the project. The net fill requirements would be met by extracting soil from locations within the SLF construction limits.

Due to the downward slope of the project area, there is a potential for erosion from runoff due to seasonal rains and possibly from water use associated with construction activities. Storm water runoff would be minor since the project would be located within an arid area where rainfall is minimal. Water for construction activities would be minimal and would be supplied from an on-site source. Construction water would be used for compaction and dust control.

Erosion control procedures would be incorporated into all aspects of the process. Erosion and sedimentation control practices would focus on minimizing clearing, implementing sound engineering and environmantally sensitive practices when diposing of excess materials, providing mechanical stability to the soil and developing soil conditions that will aid the re-establishment of vegetation. Soil stabilization and revegetation would provide long-term soil stabilization and storm water runoff control for areas disturbed during site preparation. Areas within the SLF construction limits, where site preparation work requires the removal of vegetation, would be revegetated to control erosion unless the surface is to be paved or used for construction of a structure. Revegetation would include fine grading, hydroseeding, watering, monitoring revegetated areas, and reseeding and remulching as necessary to ensure success. Revegetation efforts would use native plants.

Construction of the SLF at the Cypress Ridge alternative site would also involve a loss of approximately 6.0 ha (14.8 ac) of coastal sage scrub vegetation. This vegetation currently supports a population of *Monardella frutescens*, among other sensitive plant species. This would require the same 3:1 mitigation described above. The remaining acreage at the Cypress Ridge site is in grassland vegetation.

To minimize the losses of coastal sage scrub and *Monardella frutescens* within a coastal sage scrub community, the Cypress Ridge alternative was designed to occupy the smallest area possible (as was the facilities layout for the preferred alternative). The design also includes features which minimize the required amount of grading. Erosion control measures and revegetation would be as described for the preferred alternative.

SLF construction at the SLC-5 North alternative site would impact the Coastal Sage Scrub vegetation in a manner very similar to the preferred alternative site. In addition, there may be losses of *Monardella crispa* from construction in the Coastal Dune Scrub vegetation. Mitigation for either of these contingencies would be similar to that described above. Erosion control measures and revegetation would be as described for the preferred alternative.

#### 4.5.1.2 Launch Effects

On a local scale, flora in the vicinity of the SLF may be affected by the launch exhaust products from near-field sources, far-field depositions or from combustion products associated with catastrophic events. Effects on vegetation would be similar at each of the three alternative sites.

Within 300 feet (0.7 acre) of the flame duct opening at the launch pad, plants in direct line with the opening would be expected to be directly affected by depositions of exhaust products and increased dust during a launch (see Figure 4.12). These effects would be minor due to the design of the duct which causes the rocket exhaust to exit at a 30 degree angle to the ground. The generation of a ground cloud during a launch would impart short term changes to ambient air quality conditions. Impacts to the plant biology of the area would be a function of the weather, the behavior of the ground cloud, and the location of the biota relative to the diffusing cloud mass. Constituents within the cloud include hydrogen chloride (HCl), aluminum oxide ($Al_2O_3$), carbon monoxide (CO), and carbon dioxide ($CO_2$) (see Table 4-2). Biological contact could occur through diffusion of the HCl gas into plant leaves or the gas could dissolve into fog droplets or rainwater and contact plants. At high concentrations, effects could range from injury to leaves or flowers to leaching of nutrients through the leaves. For a variety of reasons discussed below, exposures are expected to be very low and effects on biota are expected to be minor and short-term and probably not measurable. The mechanism for direct impacts would be from contact or absorption, while indirect impact could result through changes in water quality, soil chemistry, and habitat suitability.

HCl is emitted as a gas as part of the exhaust cloud produced by the vehicle. Since the exhaust cloud is of such a transient nature due to high vehicle acceleration rates, and rises from its own heat, the ground-level air quality would be expected to approach ambient conditions within 500 m (547 yd) of the launch mount. Similarly, the dispersive qualities of the lower atmosphere would ensure that deposition from launch exhaust products or from catastrophic events would not attain toxic levels. Therefore, no changes to plants, such as discoloration, partial loss of foliage, or other effects are anticipated from direct impacts of the ground cloud. Furthermore, inasmuch as launch induced changes in water quality and soil chemistry (discussed in section 4.4.1 and 4.4.2) would be negligible and transient, biological changes generated by these indirect changes would be insignificant.

Observation of the plant communities at other active South Vandenberg AFB launch sites, such as the Titan IV pad at SLC-4, indicate that plants are able to thrive in the extreme near-field of launch events. Titan IV rockets are four times as large as the largest rocket that would be launched from the Spaceport, and uses a water sound suppression system which adds over 20,000 gallons of water to the exhaust products. The addition of this water allows hydrogen chloride (HCl) to form hydrochloric acid droplets that are deposited directly upon near-field plants at SLC-4. The Spaceport would not employ a water sound suppression system, thus eliminating the major source of acid deposition to plants. Rapid acceleration of the smaller vehicles that would be launched from the Spaceport further reduces the effects of exhaust products on near-field plants when compared with the slower, heavier Titan, because a much smaller proportion of the propellant is burned near ground level. The near-field characteristics of the exhaust from Spaceport launches would be dramatically less intense than for the Titan. Figure 4.12 shows a 0.7 acre area of potential near-field effects for rocket exhaust from launches from the Spaceport. This area would be mowed to minimize the possibility of fires and to minimize the use of this potentially hazardous area by most species of wildlife. The acreage would be mitigated at a ratio of 3:1 as required by the Monitoring and Mitigation Reqirements, Appendix G.

Figure 4.9. Distribution of Vegetation with Site Footprint Overlay - SLF Area

Figure 4.10. Distribution of Vegetation with Site Footprint Overlay - OSB / Rail Spur Area

Figure 4.11. Distribution of Vegetation with Site Footprint Overlay - Power / Comm Re-Routing

Figure 4.12. Near-Field Vegetation Effects

Even though the effects of individual launches are considered insignificant, the long-term effect of the high launch rates planned for the Spaceport is not well understood. Although Titan launches might have greater short-term impacts because of the size of the rocket motors, slow liftoff and acceleration, and the water deluge system, they are launched infrequently (no more than 2-3 Titan II and Titan IV launches per year). A concern is that the high launch rate (up to 24 per year by the year 2000) may produce additive effects on surrounding vegetation. Several factors suggest that significant additive effects would not occur. These include the fact that minimal effects are expected per launch, that susceptible plant parts (leaves, flowers) are short-lived, limiting the number of launches to which they are exposed, and that the HCl gas dissipates after a launch, and would not accumulate in the project area, (HCl that reached the surface in rain or fog would be neutralized by carbonates in the soil, which has a high buffering capacity). Monitoring and Mitigation Requirements (Appendix G) for the Spaceport project would ensure that any vegetation effects from these launch rates, including changes in animal use of the habitat, are monitored, documented, and that appropriate mitigation methods are applied.

Fires, explosions, and fuel spills, although highly improbable events, constitute potential biota-impacting accidents that could occur during Spaceport operations. Specific effects would depend upon the location and extent of the accident and the resultant primary effects (changes in noise, air quality, water quality, and thermal surrounding). Fires could begin near the launch site and burn off special habitat unless immediately contained. Subsequent natural growth would occur, but regrowth could take over 5 years depending upon the extent of the fire damage. Existing fire control measures would reduce this extent. Explosions of highly-stable solid rocket motors at the Spaceport would be unlikely, but emergency and disaster response plans are already in place at Vandenberg AFB to minimize the effects of such events. Fuel spills are also unlikely because permanent fuel storage facilities are not planned for construction at the Spaceport. Fuels required by Spaceport users would be brought to the facility in user-supplied, portable carts. Containment areas large enough to contain the entire contents of the fuel cart would be built to avoid fuel contamination of surrounding plants in the event of a spill.

It is concluded that rocket launches from any of the SLF alternatives would not have a significant impact on the natural plant communities. Monitoring would be conducted to evaluate this (see Appendix G).

#### 4.5.1.2.1 Surf Thistle and Spectacle Pod

These plant species are within the region of influence, but not expected to be impacted by the Spaceport. No monitoring or mitigation would be conducted.

#### 4.5.1.2.2 Monardella

*Monardella spp.* are within the region of influence, but not expected to be impacted by the construction and operation of the Spaceport at the preferred alternative site. No monitoring or mitigation would be conducted.

If the Cypress Ridge alternative or the SLC-5 North alternative is selected, *Monardella frutescens* or *M. crispa* would be within a short distance of the launch pad. If one these alternatives is selected, *M. spp.* would be monitored as part of the vegetation monitoring program (Appendix G).

#### 4.5.1.2.3 Black-flowered Figwort

This plant species is outside of the region of influence of the preferred alternative and the Cypress Ridge alternative. Construction of the Spaceport at either of these alternative sites would not impact the black-flowered figwort. No monitoring or mitigation would be conducted.

Black-flowered figwort would be within the region of influence of the SLF-5 North alternative site for the SLF. If this alternative is selected, the black-flowered figwort would be monitored as part of the vegetation monitoring program (Appendix G).

**4.5.2 Wetlands and Associated Wildlife**

Two areas in the vicinity of the preferred alternative site scored positive for the three Corps criteria for wetland determination: hydrology, dominant vegetation, and soils characteristics. These areas are a ditch near the former storage facility asphalt pad, and a pool of water in a trench south of the retention pond. The pool area is off-site and would not be disturbed during construction activities. The ditch area meets the Corps criteria for a wetland not normally considered jurisdictional, that is, “Non-tidal drainage and irrigation ditches excavated on dry land” (Federal Register Vol. 51, No. 219, p. 41217, Nov. 13, 1986).

Cañada Honda Creek is approximately 3.7 km (2.3 mi) to the north of the proposed site for the SLF and 4.9 km (3.0 mi) north of the Cypress Ridge alternative site. Because the prevailing winds are from the north and northwest, there is a 10 percent chance that this drainage basin would be downwind during any launch from either of these sites. This means that of a maximum of 24 launches planned from the Spaceport, only 2 to 3 would be expected to have meteorological conditions favorable to deposition of any kind into the Honda Creek area. In the event that winds are from the south during rocket launches and the exhaust plume passes over Cañada Honda Creek, exhaust dispersion modeling indicates that the 30 minute average concentrations of atmospheric HCl would be less than 0.30 ppm (Nyman 1993), which is well below maximum allowable toxic exposure limits (5 ppm) for hydrogen chloride. Due to the low concentrations of HCl that could possibly be deposited in the Honda Creek area from Spaceport launches, and the fact that wind conditions are not favorable for any deposition at least 90 percent of the time, launches from the preferred alternative site or from the Cypress Ridge alternative site would not have significant impacts to the fish, wildlife or riparian habitats of Cañada Honda Creek.

Although it is assumed that Cañada Honda Creek would not be significantly impacted by rocket launches from the Spaceport that would be built at either the preferred alternative site or the Cypress Ridge alternative site, monitoring would be conducted during Spaceport launches when the winds are from the south to evaluate possible per-launch and additive effects to Honda Creek water quality and vegetation.

The SLC-5 alternative location of the SLF would be approximately 1.0 km (0.6 mi) to the north of Cañada Honda Creek. As such, the near-field exhaust plume would pass over this riparian wetland during most launches. This may have a significant impact to the fish and wildlife of this drainage. Threatened or Endangered species are discussed separately in section 4.5.4.

**4.5.2.1 Southwestern Pond Turtle**

This species would not be expected to be impacted by launches from the preferred alternative due to the distance from the launch site and the fact that prevailing winds are from the north, away from Honda Canyon. However, water quality and vegetation monitoring would be conducted to verify that there are no launch effects for Honda Creek during those launches where wind directions are predicted which could cause minor plume deposition in the drainage. This species is outside the region of influence of the Cypress Ridge alternative.

If the SLC-5 North alternative is selected, this species would be within the region of influence and would be monitored for launch effects. The frequency of launches planned, and the prevailing winds (NW to SE) increase the likelihood of impacts to this drainage. Mitigation would be implemented if there is evidence of significant impact related to launches from the SLC-5 North alternative.

**4.5.2.2 Two-striped Garter Snake**

This species would not be expected to be impacted by launches from the preferred alternative due to the distance from the launch site and the fact that prevailing winds are from the north, away from Honda Canyon. However, water quality and vegetation monitoring would be conducted to verify that there are no launch effects for Honda Creek during those launches where wind directions are predicted which could cause minor plume deposition in the drainage. This species is outside the region of influence of the Cypress Ridge alternative.

If the SLC-5 North alternative is selected, this species would be within the region of influence and would be monitored for launch effects. The frequency of launches planned, and the prevailing winds (NW to SE) increase the likelihood of impacts to this drainage. Mitigation would be implemented if there is evidence of significant impact related to launches from the SLC-5 North alternative.

#### 4.5.2.3 Tiger Salamander

This species would not be expected to be impacted by launches from the preferred alternative due to the distance from the launch site and the fact that prevailing winds are from the north, away from Honda Canyon. However, water quality and vegetation monitoring would be conducted to verify that there are no launch effects for Honda Creek during those launches where wind directions are predicted which could cause minor plume deposition in the drainage. This species is outside the region of influence of the Cypress Ridge alternative.

If the SLC-5 North alternative is selected, this species would be within the region of influence and would be monitored for launch effects. The frequency of launches planned, and the prevailing winds (NW to SE) increase the likelihood of impacts to this drainage. Mitigation would be implemented if there is evidence of significant impact related to launches from the SLC-5 North alternative.

### 4.5.3 Upland Wildlife

#### 4.5.3.1 Construction Impacts

Construction of the SLF at any of the alternative sites would cause individual wildlife populations to decrease in the immediate area. Specifically, this might impact some Category 2 species which are assumed to breed in the vicinity. These species, including the loggerhead shrike, Bell's sage sparrow, southern California rufous-crowned sparrow and California horned lark, are all regionally distributed. If these species do nest on the specified SLF site, the expected worst-case impact would be the displacement of several pairs for each species. To further minimize potential impacts to candidate species which may nest at the SLF site, the commencement of new grading would be avoided during the nesting season, approximately March 1 through July 31.

Construction staging areas would be restricted to previously disturbed sites. All human activities would be limited to construction areas and staging areas. The loss of coastal sage scrub habitat would be mitigated on a 3:1 ratio. This mitigation would reduce impacts on candidate species displaced by construction. Coastal sage scrub vegetation temporarily disturbed during construction would be mitigated onsite on a 1:1 basis. Marine mammals, seabirds, peregrine falcons, and other resources along the coast within the region of influence would not be affected by construction-related disturbance.

#### 4.5.3.2 Operations Impacts

Upland wildlife populations in the vicinity of the SLF may be affected by the launch exhaust products from near-field sources, far-field depositions, from combustion products associated with catastrophic events, launch noises, or other sources such as pre-launch security sweeps. Effects on wildlife would be similar at each of the three alternative sites.

##### 4.5.3.2.1 Launch Exhaust Impacts

Within 300 feet of the flame duct opening at the launch pad, plants and wildlife habitat in direct line with the opening would be expected to be directly affected by minor depositions of exhaust products and dust during a launch. These effects would have a minor impact upon the biota due to the design of the duct which causes the rocket exhaust to exit at a 30 degree vertical angle to the ground. However, the frequency of launches (up to 24 per year when the Spaceport is fully operational) may preclude the use of a small area by wildlife. This area is shown on Figure 4.12.

The generation of a ground cloud during a launch would impart short-term changes to ambient air quality conditions. Impacts to the animal biology of the area would be a function of the weather, the behavior of the ground cloud, and the location of the animals relative to the diffusing cloud mass. Constituents within the cloud include hydrogen chloride (HCl), aluminum oxide ($Al_2O_3$), carbon monoxide (CO), carbon dioxide ($CO_2$), and nitrogen oxides ($NO_X$). However, the exhaust cloud is of a minor and transient nature due to small vehicle size (in comparison with other launch vehicles currently operating at Vandenberg AFB; Titan II, Titan IV, Atlas, etc.). Comparatively high vehicle acceleration rates would also limit the size of the ground cloud in the vicinity of the launch pad. The cloud also tends to rise from its own heat, further reducing the ground level effects. Ground-level air quality would be expected to approach ambient conditions within 500 m (547 yd) of the launch mount. Similarly, the dispersive qualities of the lower atmosphere would ensure that far-field deposition from launch exhaust would not attain toxic levels.

Observation of the plant and animal communities at other active South Vandenberg AFB launch sites, such as the Titan IV pad at SLC-4, indicate that wildlife is able to thrive in the near-field effect areas of launch events. Titan IV rockets are four times as large as the largest rocket that would be launched from the Spaceport, and use a water sound suppression system which adds over 20,000 gallons of water to the exhaust products. The addition of this water allows hydrogen chloride (HCl) to form hydrochloric acid droplets that are deposited directly upon near-field wildlife habitats at SLC-4. The Spaceport would not employ a water sound suppression system, thus eliminating the major source of acid deposition. Titan launch vehicles are also much heavier than rockets that would be launched from the Spaceport, and tend to “dwell” over the launch duct longer. The near-field characteristics of the exhaust from Spaceport launches would be dramatically less intense than for the Titan.

The following discussion will focus on the LLV 2, which is one of the largest launch vehicles under consideration. Other launching systems will also be discussed where relevant information is available. These launch vehicles will be contrasted with the Titan IV and the Space Shuttle (USAF 1989a, USAF 1983). The latter two vehicles will serve as very conservative estimates of the upper limit of environmental effects because they are much larger than any launch vehicle that would be serviced by the SLF. Furthermore, the previous environmental analyses for these launch vehicles indicate that there would be no significant impacts to terrestrial and marine animal life as a result of the far-field deposition of the exhaust emission.

Analyses of actual exhaust plumes associated with Space Shuttle launches at Kennedy Space Center support the previous modeling results that no far-field impact to plants or animals would occur. First, it was observed that the measured HCl deposition levels were equal to or less than those predicted by the model (Schmalzer et al. 1986). Second, although far-field deposition occurred over a wide area, cumulative effects to the environment were not apparent (Schmalzer et al. 1993). During this study, a total of 43 launches of the Space Shuttle in a ten year period were evaluated without documenting any far-field effects to wildlife species. This includes Federally listed Florida scrub jays and wood storks, which nest within 800 m (2650 ft) of the nearest Shuttle pad. Other species evaluated include alligators.

While the data from the exhaust plume studies conducted for Space Shuttle missions in Florida, and data available from other programs, make the case that launches from the Spaceport, on a per-launch basis, would not significantly impact local vegetation and wildlife habitats, the effects of significantly higher launch rates anticipated for the Spaceport are not well understood. For instance, Titan launches might have greater short-term impacts because of the size of the rocket and the water deluge system, but they are launched infrequently (no more than 2-3 Titan II and Titan IV launches per year). A high launch rate (up to 24 per year) may produce additive effects. While Vandenberg has experienced launch rates far in excess of those planned for the Spaceport, information is not available for these higher launch rates. Therefore, although it is certain that per-launch noise and exhaust effects would be far less for Spaceport launches than for the Space Shuttle, Titan, and other programs, monitoring would be conducted to assess additive or cumulative, as well as per-launch impacts of Spaceport launches on native plants and wildlife.

A 2.5 year study of Titan III launches at Cape Canaveral Air Force Station, Florida, resulted in similar conclusions (Larson et al. 1993). In this evaluation, Florida scrub jays, which are Federally listed as Threatened, were studied for impacts from Titan III launches. Although some of the nests were within 250 m (771 ft) of the Titan launch mount, no mortality or negative impacts to the adults or young were observed as a result of near-field or far-field effects.

REEDM modeling, under a variety of weather conditions, indicated that launches of the LLV 2 would produce lower HCl emissions and depositions than observed for larger launch systems such as the Titan III and the Space Shuttle. For instance, the maximum atmospheric concentrations of HCl during a Titan III launch was measured at 25 ppm (Pellett et al. 1983). In contrast, the maximum predicted 30 minute average HCl concentration for the LLV 2 is 0.3 ppm, while the predicted maximum instantaneous HCl concentration is 8.2 ppm (Nyman 1993). This compares favorably with the threshold limit for average and sensitive humans of 5 ppm. Moreover, most of this atmospheric HCl would pass over the Pacific Ocean, directly south of the SLF.

Bell's sage sparrows, rufous-crowned sparrows, and burrowing owls have been observed within the region of influence of each alternative site and could be displaced by the high launch rates contemplated. These species would be monitored for launch impacts, especially in relation to the effects of higher launch rates. If a significant impact, such as reduced habitat usage, is shown to be caused by rocket launches from the Spaceport, mitigation would be implemented in consultation with the VAFB and USFWS (see Appendix G, Monitoring and Mitigation Requirements).

#### 4.5.3.2.2 Launch Noise Impacts

Comparative analyses of launch noises were also evaluated for their potential effects on wildlife (See Appendix F for a discussion of sound). This was done by comparing acoustic outputs from the Castor 120™ to the Space Shuttle and the Titan IV. The rocket motor is the main booster for the Lockheed Launch Vehicle (LLV) and the Taurus. The smaller Castor IV™ serves as the main engine for the Conestoga and the Orbex and produces less noise than the Castor 120™. The remaining types of launch vehicles produce less noise than LLV or the Taurus because they are smaller or employ liquid-fueled boosters.

To accomplish the noise analysis, data were obtained for acoustic outputs of the Castor 120™ motor during two static tests (Buhaly 1993). Next, complementary data were obtained from modeling of the Advanced Solid Rocket Motor (ASRM) and for launches of the Titan IV/Centaur. The ASRM acoustic model was developed, as part of the Space Shuttle program, for static tests of a single solid rocket motor (NASA 1989). This model underestimates the noise levels of a Space Shuttle launch which includes two ASRMs and three main engines. The Titan IV/Centaur data were generated for the atmospheric conditions which commonly occur at South Vandenberg AFB (USAF 1989a). Similar and consistent results were obtained for monitoring of actual Titan IV launches at South Vandenberg (DoD 1994). Finally, each of these datasets are graphed, in dB and dBA units, against distance from the source (Figure 4.13).

Figure 4.13 indicates that the noise outputs from a rocket launch using a Castor 120™ as a booster would be less than launch noises from the Space Shuttle or the Titan IV/Centaur. At a distance of 1.2 km (0.75 mi), noise from a Castor 120™ would be approximately 101 dBA (124 dB). According to Figure 4.13, launches from the SLF would produce approximately 93 dBA (115 dB) at Rocky Point. At distances greater than 3.2 km (2.0 mi), the Castor 120™ produces noises less than or equal to 90 dBA (116 dB).

Launch noises produced by the Aquila and the Minuteman rocket motors are less than noises produced by the LLV 2. Measurements made during static firing indicated that noise levels were 136.4 dB (126 dBA, estimated) at 76.2 m (250 ft). At a distance of 1860 m (6100 ft), the noise levels decreased to 92.3 dB (71 dBA, estimated).

It is unlikely that launch noises in the range expected for vehicles that would be launched from the Spaceport would have a significant impact on wildlife. However, due to the frequency of launches planned for the Spaceport, this would be evaluated by monitoring of launch noise effects to wildlife.

**4.5.3.2.3 Other Impacts**

Fires, explosions, and fuel spills, although highly improbable events, constitute potential wildlife-impacting accidents that could occur during Spaceport operations. Specific effects would depend upon the location and extent of the accident and the resultant primary effects (changes in noise, air quality, water quality, and thermal surrounding). Fires could begin near the launch site and burn off special habitat unless immediately contained. Wildlife would be displaced from the habitat until regrowth occurred. Subsequent natural growth would occur, but regrowth could take over 5 years depending upon the extent of the fire damage. Existing fire control measures would reduce this extent.

Explosions of highly-stable solid rocket motors at the Spaceport would be unlikely, but emergency and disaster response plans are already in place at Vandenberg AFB to minimize the effects of such events. Observations of nearby wildlife habitat after the Titan 34-D explosion at SLC-4 in April 1986 showed that the occurrence of such impact would not be significant (USAF 1989a), especially since the rockets planned for launch at the Spaceport are, at most, only one-quarter the size of Titan rockets. Fuel spills are also unlikely because construction of a permanent fuel storage facility is not planned at the Spaceport. Fuels required by Spaceport users would be brought to the facility in user-supplied, portable carts. Containment areas large enough to contain the entire contents of the fuel cart would be built to avoid fuel contamination of surrounding plants and wildlife in the event of a spill.

Another potential impact from operations at the Spaceport stems from the need to evacuate portions of Vandenberg AFB during launch events. Certain areas of South Vandenberg AFB must be completely evacuated before a launch. Evacuation of personnel must be verified by direct observation. Air Force safety officials would establish impact limit lines for each launch from the Spaceport. These arbitrarily established limit lines ensure that debris from a launch failure does not impact in populated areas. The size and extent of the lines depend upon the launch site and the type of vehicle being launched.

For launches from the preferred alternative site and the Cypress Ridge alternative site, the limit lines would extend as far north as the access road for SLC-4. This would accommodate the largest vehicles planned for launch from the Spaceport (R. Cortopassi, VAFB, personal communication, October 1994). Helicopter patrols would begin approximately 3 hours prior to launch. A single helicopter would be used to patrol ocean and land areas at altitudes of 300 ft to 1,000 ft (Lt P. Doty, VAFB, personal contact, November 1994). The flight would be offset by 300 yards at altitudes of 300 feet or more from the harbor seal rookery. The helicopter would intermittently pass near the launch site, and all areas within the impact limit lines several times. These flights have a negligible effect upon wildlife in the area, and are justified by safety and security concerns.

No All Terrain Vehicle (ATV) patrols of upland areas would be required for impact limit lines that extend no farther north than SLC-4, as is the case for the preferred alternative site and the Cypress Ridge alternative. However, for the SLC-5 North alternative, impact limit lines would be established proportionately farther north, depending upon the launch vehicle. While no patrols are necessary in upland areas, Air Force personnel would patrol as much as 1.5-2.0 miles of beach area with ATVs to ensure evacuation prior to a launch. Potential impacts from ATV patrols of beach areas are discussed in section 4.5.4.3.3. Since ATV patrols of upland areas do not occur, no impact to upland wildlife species would be anticipated for launches from any of the alternative sites.

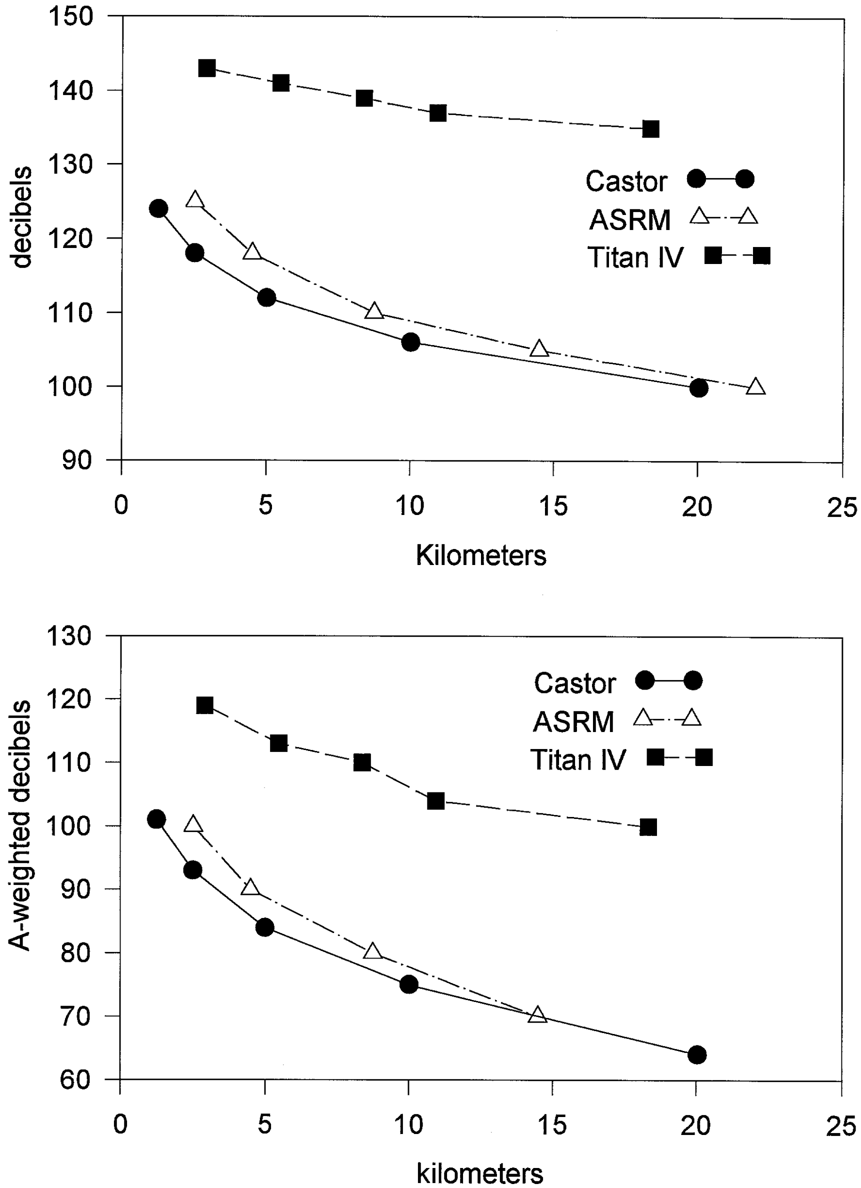



Figure 4.13. Launch Noise vs. Distance from the Launch Site

### 4.5.4 Threatened and Endangered Species

#### 4.5.4.1 Fish

##### 4.5.4.1.1 Unarmored Threespine Stickleback

This species would not be expected to be impacted by Spaceport launches if the Spaceport is constructed at the preferred alternative site due to prevailing winds from the NW to the SE, and the low exhaust product deposition rates anticipated. However, for approximately 10 percent of the year, winds from the south are possible. If exhaust plume modeling indicates a potential for unacceptable rates of deposition at Honda Creek under these unusual wind conditions, a water quality survey would be conducted to determine if exhaust product deposition has occurred. If data show that launches from the Spaceport result in a detrimental impact to Honda Creek and adjacent riparian habitat, restrictions on the number and timing of launches that may occur under certain weather conditions would be imposed to avoid adverse impacts to Honda Creek.

This species would be outside the region of influence of the Cypress Ridge alternative. Therefore, it would not be monitored nor mitigated if the Cypress Ridge alternative is chosen for the construction of the Spaceport.

If the SLC-5 North alternative is selected, this species would be within the region of influence and would be monitored for launch effects. If exhaust plume modeling indicates a potential for unacceptable rates of deposition at Honda Creek, water quality and vegetation would be conducted to determine if impacts have occurred. If data shows that launches from the Spaceport result in a detrimental impact to Honda Creek and adjacent riparian habitat, restrictions on the number and timing of launches that may occur under certain weather conditions would be imposed to avoid adverse impacts to Honda Creek. There would be a greater potential for impact to this species if the SLC-5 North alternative is chosen for the construction of the Spaceport project.

##### 4.5.4.1.2 Tidewater Goby

This species would not be expected to be impacted by Spaceport launches if the Spaceport is constructed at the preferred alternative site due to prevailing winds from the NW to the SE, and the low exhaust product deposition rates anticipated. However, for approximately 10 percent of the year, winds from the south are possible. If exhaust plume modeling indicates a potential for unacceptable rates of deposition at Honda Creek under these unusual wind conditions, a water quality survey would be conducted to determine if exhaust product deposition has occurred. If data show that launches from the Spaceport result in a detrimental impact to Honda Creek and adjacent riparian habitat, restrictions on the number and timing of launches that may occur under certain weather conditions would be imposed to avoid adverse impacts to Honda Creek.

This species would be outside the region of influence of the Cypress Ridge alternative. Therefore, it would not be monitored nor mitigated if the Cypress Ridge alternative is chosen for the construction of the Spaceport.

If the SLC-5 North alternative is selected, this species would be within the region of influence and would be monitored for launch effects. If exhaust plume modeling indicates a potential for unacceptable rates of deposition at Honda Creek, water quality and vegetation would be conducted to determine if impacts have occurred. If data shows that launches from the Spaceport result in a detrimental impact to Honda Creek and adjacent riparian habitat, restrictions on the number and timing of launches that may occur under certain weather conditions would be imposed to avoid adverse impacts to Honda Creek. There would be a greater potential for impact to this species if the SLC-5 North alternative is chosen for the construction of the Spaceport project.

#### 4.5.4.2 Reptiles and Amphibians

#### 4.5.4.2.1 California Red-legged Frog

This species would not be expected to be impacted by Spaceport launches if the Spaceport is constructed at the preferred alternative site due to prevailing winds from the NW to the SE, and the low exhaust product deposition rates anticipated. However, for approximately 10 percent of the year, winds from the south are possible. If exhaust plume modeling indicates a potential for unacceptable rates of deposition at Honda Creek under these unusual wind conditions, a water quality survey would be conducted to determine if exhaust product deposition has occurred. If data show that launches from the Spaceport result in a detrimental impact to Honda Creek and adjacent riparian habitat, restrictions on the number and timing of launches that may occur under certain weather conditions would be imposed to avoid adverse impacts to Honda Creek.

This species would be outside the region of influence of the Cypress Ridge alternative. Therefore, it would not be monitored nor mitigated if the Cypress Ridge alternative is chosen for the construction of the Spaceport.

If the SLC-5 North alternative is selected, this species would be within the region of influence and would be monitored for launch effects. If exhaust plume modeling indicates a potential for unacceptable rates of deposition at Honda Creek, water quality and vegetation would be conducted to determine if impacts have occurred. If data shows that launches from the Spaceport result in a detrimental impact to Honda Creek and adjacent riparian habitat, restrictions on the number and timing of launches that may occur under certain weather conditions would be imposed to avoid adverse impacts to Honda Creek. There would be a greater potential for impact to this species if the SLC-5 North alternative is chosen for the construction of the Spaceport project.

#### 4.5.4.3 Birds

The seaward-facing cliffs and associated coastal habitats to the west of the preferred alternative site may be impacted by launch noise or by far-field deposition during rocket launches. This may influence peregrine falcons, brown pelicans, and nesting seabirds that utilize these areas. This is also true of the Cypress Ridge alternative, and, to a lesser degree the SLC-5 North alternative. The Cypress Ridge and SLC-5 North alternatives, located 0.7 miles farther south and 1.5 miles farther north respectively, are more distant from these habitats.

Launches from the preferred alternative site would be limited to launch azimuths between 168 degrees and 220 degrees from true north. This would prevent direct overflight of most of the habitat of the nesting and roosting birds.

Launches of the Minuteman missile at VAFB had no significant effect on the behavior of the least tern (Atwood et al. 1981). In another study, three species of seabirds were less responsive to launch noise levels, ranging from 130 dB to 140 dB, than they were to other forms of human disturbances (Schreiber and Schreiber 1980). Similar results were obtained for roosting seabirds and pinnipeds (Bowles and Stewart 1980).

Launches of the Space Shuttle from the Kennedy Space Center are revealing with respect to their noise effects on a colony of endangered wood storks (Smith 1990). This colony was located within 1.3 km (0.8 mi) south of Launch Complex 39A and received peak noise levels up to 144.5 dB (137.7 dBA, estimated) during three launches of the Shuttle (STS-30, STS-31 and STS-32). In spite of these disturbances, this wood stork colony produced 1 to 3 young per nest for several years.

Monitoring of the endangered wood stork, conducted during the breeding season (April 24, 1990), indicated that adults responded to noises from a Space Shuttle launch by flying away from the nests, but returned within 2 to 4 minutes (Smith 1990). By 10 minutes after the launch of the Space Shuttle, the adults and juveniles appeared to be interacting normally. Furthermore, there were no young knocked from the nests as a result of the adults being startled. Similar results were obtained from monitoring during launches of the Titan IV.

Scrub jays, some within 250 m (771 ft) of Titan launch complexes at Cape Canaveral, have also been studied for their responses to launch noise (Larson et al. 1993). No mortality, impacts to the behavior, or reductions in habitat use by this Threatened species were related to noise from these launches. Although noise levels were not measured in conjunction with the scrub jay study, unrelated monitoring of Titan III launch noises were conducted at these launch facilities (Brown 1990). The resulting 1-minute, time-weighted average noise levels were as much as 128 dBC (115.4 dBA, estimated).

#### 4.5.4.3.1 Peregrine Falcon

Peregrine falcon and prairie falcon have been studied to determine their responses to loud noises. Ellis et al. (1991) found that peregrine falcon behavioral and reproductive responses to real and simulated sonic booms are minimal. Of 12 peregrine nests tested for noise disturbance during the nesting cycle, 83 percent (10) fledged young. The reoccupancy and productivity rates for these test nests, were within or above expected values for self-sustaining falcon populations (Ellis et al. 1991, Newton 1979).

Ellis et al. (1991) also documented the effects of sound disturbance to prairie falcons, a species similar to the peregrine falcon in its behavior and nesting requirements. Four pairs of prairie falcons were subjected to noises from jet aircraft during the courtship and incubation phases of breeding. All four pair successfully produced young.

Similarly, Holthuijzen et al. (1990) investigated the effects of construction and mine blasting on prairie falcons. This study documented behavioral reactions by prairie falcons to blasting. Some of this blasting occurred within 100 m (330 ft) of the nests. Incubating and brooding falcons flushed from nests in 25 of 112 mine blasts (22 percent), but returned to their nests within 3.4 minutes.

Holthuijzen et al. (1990) stated, in regards to prairie falcons, that blasting done after nest selection and before the fledging period would not need to be restricted if it was at least 125 m (410 ft) from the nest and peak noise levels did not exceed 140 dB at the eyrie. This study concluded that, in general, blasting had no severe adverse effects on this species behavioral patterns, productivity or occupancy of nesting sites.

The peregrine nest sites are located on a series of cliffs that generally face seaward and to the west, away from the SLF. Nesting peregrine falcons can be highly variable in their response to human induced disturbances (Cade et al. 1988). Some are sensitive to perturbations while others are habituated to heavily populated cities.

The effects of aircraft overflight noise and sonic booms on the reproductive success of raptorial birds have also been reviewed (Awbrey and Bowles 1990, Bowles et al. 1990). This summary of nine studies concluded that there was no statistically detectable effect of aircraft noise on reproductive success in raptors. Furthermore, none of the studies reported losses of young which could be attributed to aircraft overflights, either from panic response or from abnormal parental behavior.

Peregrine falcons may nest in the region of influence of the preferred alternative or the Cypress Ridge alternative. Therefore, a hacking program as specified in the Monitoring and Mitigation Requirements, Appendix G, and in accordance with approved methods determined by Vandenberg AFB natural resources personnel and the US Fish and Wildlife Service, would be introduced to offset any potential impacts.

#### 4.5.4.3.2 California Brown Pelican

This species is known to roost in the region of influence of the preferred alternative, and the Cypress Ridge alternative. Therefore, monitoring would be conducted or mitigation would be implemented before the first launch from the Spaceport if either of these alternatives is chosen for the construction project (See Appendix G).

#### 4.5.4.3.3 Western Snowy Plover

Many of the beaches, lagoons and other coastal habitats north of Point Pedernales are important nesting and breeding habitat for species of concern, including the western snowy plover. Snowy plovers also occur at Jalama Beach. Because these areas are outside the region of influence of the preferred alternative site and the Cypress Ridge alternative site, they would not be impacted by Spaceport rocket launches. Therefore, this species would not be monitored nor mitigated.

The SLC-5 North alternative location for the SLF is approximately 0.5 km (0.3 mi) from the nearest coastline. Snowy plovers are known to winter in this area. Therefore, there would be a potential for rocket launches from the SLC-5 North alternative to impact this threatened species. The most probable source of impact would be the patrols necessary to ensure the evacuation of beach areas on South Vandenberg AFB for safety purposes. ATVs are used to patrol the beaches prior to a launch. These patrols would be conducted by only 2 specifically trained US Air Force Fish and Game personnel (MSgt Mercier, VAFB, personal communications). These individuals are trained to avoid sensitive wildlife habitat located on the beaches. Due to the limited nature of these patrols, and the training afforded to the Air Force personnel involved, the ATV patrols would have a negligible impact upon the beach area habitat. Monitoring would be conducted to evaluate this. If a significant impact was detected, and shown to be related to launches from the SLC-5 North site, mitigation would be initiated in consultation with VAFB and USFWS.

#### 4.5.4.3.4 California Least Tern

This species is outside the region of influence of the Spaceport for all alternative sites. Therefore, it would not be monitored nor mitigated.

### 4.5.4.4 Mammals

#### 4.5.4.4.1 Southern Sea Otter

This species is known to visit the South Vandenberg coastline and may be expanding its range. Launch effects are not expected to impact this species, but monitoring of southern sea otters would be conducted as specified in Appendix G, Monitoring and Mitigation Requirements.

### 4.5.5 Pinnipeds

Pinnipeds have been studied for their responses to launch noises. It is not likely that the northern fur seal, northern elephant seal, and sea lions would be impacted by noises from rocket launches because they do not occur along Rocky Point in significant numbers. On the other hand, harbor seals extensively use Rocky Point, and associated coastal habitats, as a haulout and pupping area and this species is more sensitive to loud noises.

Prior reports have examined the idea that fleeing seals could leave very young pups on the beach, thereby impairing their chances of survival (Bowles and Stewart 1980, Stewart et al. 1988). Harbor seals at Rocky Point were observed to flee into the water in response to launch noises (101.8 dBA, 145 dB) from a Titan IV launch at SLC-4, which is about 10.5 km (6.5 mi) to the north (Stewart et al. 1993). Seventy-five percent of these seals returned to shore later that day. No mortality to young or adult harbor seals was observed. Haulout patterns appeared to be normal during the next several days after this launch.

A recent Taurus launch from North Vandenberg AFB was also monitored for its noise effects on harbor seals (Stewart et al. 1994). Noise levels and behavioral responses were monitored at Purisima Point, as well as at Rocky Point. At Purisima Point, a distance of 2.25 km (1.4 mi), the launch noise reached 108.1 dBA. All 23 harbor seals fled into the water and most did not return within 3 hours. No mortality nor long-term behavioral effects to harbor seals were observed.

At Rocky Point, the Taurus launch noise was lower, 80 dBA, than at Purisima Point (Stewart et al. 1994). Twenty of 74 harbor seals fled into the water in response to this noise. Most returned to the haulout area within 30 minutes. None of the four young pups were injured or separated from their mother during this event. No mortality nor long-term behavioral effects to harbor seals were observed. Harbor seals are impacted by launch noises ranging from 80 dBA to 110 dBA (See Appendix F for a discussion of sound). There is no significance associated with this noise intensity.

To what extent high frequency or high pressure sounds detrimentally affect the reproduction of harbor seals remains poorly understood and is the topic of ongoing studies (see Stewart et al. 1993). To the best of our knowledge, no population effects, resulting from launch noise or booms have been documented for harbor seals. The results of studies prepared about the potential effects of the Space Shuttle sonic booms generally concluded that significant adverse effects on populations of mammals, including harbor seals were unlikely (USAF 1983). More recently, analyses for the Atlas II concluded that "despite rather intensive, long-term studies, no evidence has been found to confirm that dangerous leaping, self-damage, crushing, or breeding colony abandonment occur with either marine birds or marine mammals as a result of startle responses brought on by sonic booms or loud overflights" (Versar, Inc. 1991:3-48).

It is expected that harbor seals would startle in response to launch noises from the Spaceport. However, this is not expected to cause mortality, reduced reproduction, or abandonment of the haulout and breeding sites. Consultation with the National Marine Fisheries Service (NMFS) resulted in a recommendation that WCSC request NMFS to authorize the incidental harassment of harbor seals at Rocky Point during launches from the Spaceport. This authorization would require monitoring and reporting of noise levels and responses of harbor seals to the launches and compliance with other terms and conditions. WCSC would apply for this authorization prior to construction start, and obtain the authorization prior to the first launch from the Spaceport. A monitoring program would be established to monitor harbor seal responses. If the results of the monitoring reveal that the affect of the launches is more than incidental harassment, NMFS may recommend further actions be taken.

### 4.5.6 Channel Islands

The southerly azimuths of typical launch trajectories from the SLF could affect the Channel Islands. During these launches, it is possible for focused sonic booms to occur over San Miguel Island and possibly Santa Rosa Island (See Appendix F for a discussion of sound). The occurrence and intensity of sonic booms would vary according to the type of launch vehicle, the launch trajectory, and the weather conditions at the time of liftoff. Assuming typical weather conditions, predictions of sonic boom intensities at the Channel Islands are discussed below for selected launch vehicles.

Sonic boom intensities from launches of the LLV 2 have been studied in detail (Plotkin 1993). The maximum overpressures of these sonic booms over Harris Point, on the northern portion of San Miguel Island, are estimated to be 1.0 psf (Figure 4.14). Conversion of these overpressure levels to the C-weighted Sound Exposure Level (CSEL or dBC) scale results in a predicted maximum of about 100 dBC (Figure 4.15). The corresponding A-weighted sound exposure level would be 79.5 dBA. Point Bennett and the southern portions of San Miguel Island are expected to experience about 90 dBC.

For the LLV 1 under typical launch and weather conditions, the sonic boom levels on San Miguel Island would be less than for the LLV 2 (Page 1994). Depending on the measurement system of interest, the maximum intensities of LLV 1 sonic booms on San Miguel Island would be approximately 0.4 psf, 62 dBA, 108 dBB, or 94 dBC.

The LLV 3 would have a slower rate of acceleration at liftoff than either the LLV 1 or the LLV 2. As a result, the sonic booms created by the LLV 3 would begin farther to the south and not intercept any portion of the Channel Islands (Page 1994).

Sonic booms with overpressures of 1.0 psf or less are not considered excessive. For example, the overpressures directly under a Concorde passenger jet, in level flight at Mach 1.3 and 15 km altitude, are about 2.0 to 2.5 psf (Evans et al. 1979).

If Space Shuttle missions had flown from Vandenberg AFB, it was predicted that sonic booms over the Channel Islands would have maximum focus overpressures of 20 to 30 psf at ground level. This is approximately 8-10 times the intensity of the maximum overpressures expected from the largest vehicles that would be launched from the SLF. While no data exist to verify the Space Shuttle model, the Space Shuttle environmental analyses concluded that these booms would likely have no significant effect on marine and terrestrial animal life in the Channel Islands (Evans et al. 1979, Bowles and Stewart 1980, Schreiber and Schreiber 1980).

The potential effects of sonic booms on pinniped species are also considered. Previous monitoring of harbor seals, by Stewart et al. (1993), indicated that these pinnipeds tend to flee temporarily into the water when noises associated with rocket launches equal or exceed 101.8 dBA (145 dB). Although noises from rocket launching and sonic booms may not be directly comparable, the results provided by Stewart et al. (1993) are useful threshold values.

The effects of sonic booms on birds and pinnipeds of San Miguel Island are expected to be well within the range of other rocket launching programs that were considered at Vandenberg AFB (e.g. USAF 1990). The LLV 2 would produce the most intense sonic boom of any Spaceport launch vehicle analyzed, about 79.5 dBA. This would be well within the threshold values of 101.8 dBA identified by Stewart et al. (1993). Therefore, it is concluded that sonic booms from rocket launches at the SLF would not adversely affect any species that utilize San Miguel or Santa Rosa Islands.

It is concluded that the fauna of the Channel Islands would not be significantly affected by launches from any of the Spaceport alternative locations. Therefore, monitoring would not be conducted nor would mitigation be implemented.

### 4.5.7 No-Action Alternative

There would be no impacts to biological resources from the No-Action alternative.

## 4.6 Health and Safety

Space launch activities attend numerous safety hazards that result from the high concentration of energy, hazardous materials, and large structures and rockets. However, the Spaceport launch activities would result in totally manageable risks to human health and safety. All activities associated with the Spaceport would be monitored by the Air Force and conducted in accordance with the applicable regulations and accepted procedures. Vandenberg AFB maintains a strong ground and flight safety program which includes control of the Western Range operations. In addition, the Spaceport would prepare a Program Safety Plan before activities begin at the IPF and the SLF.

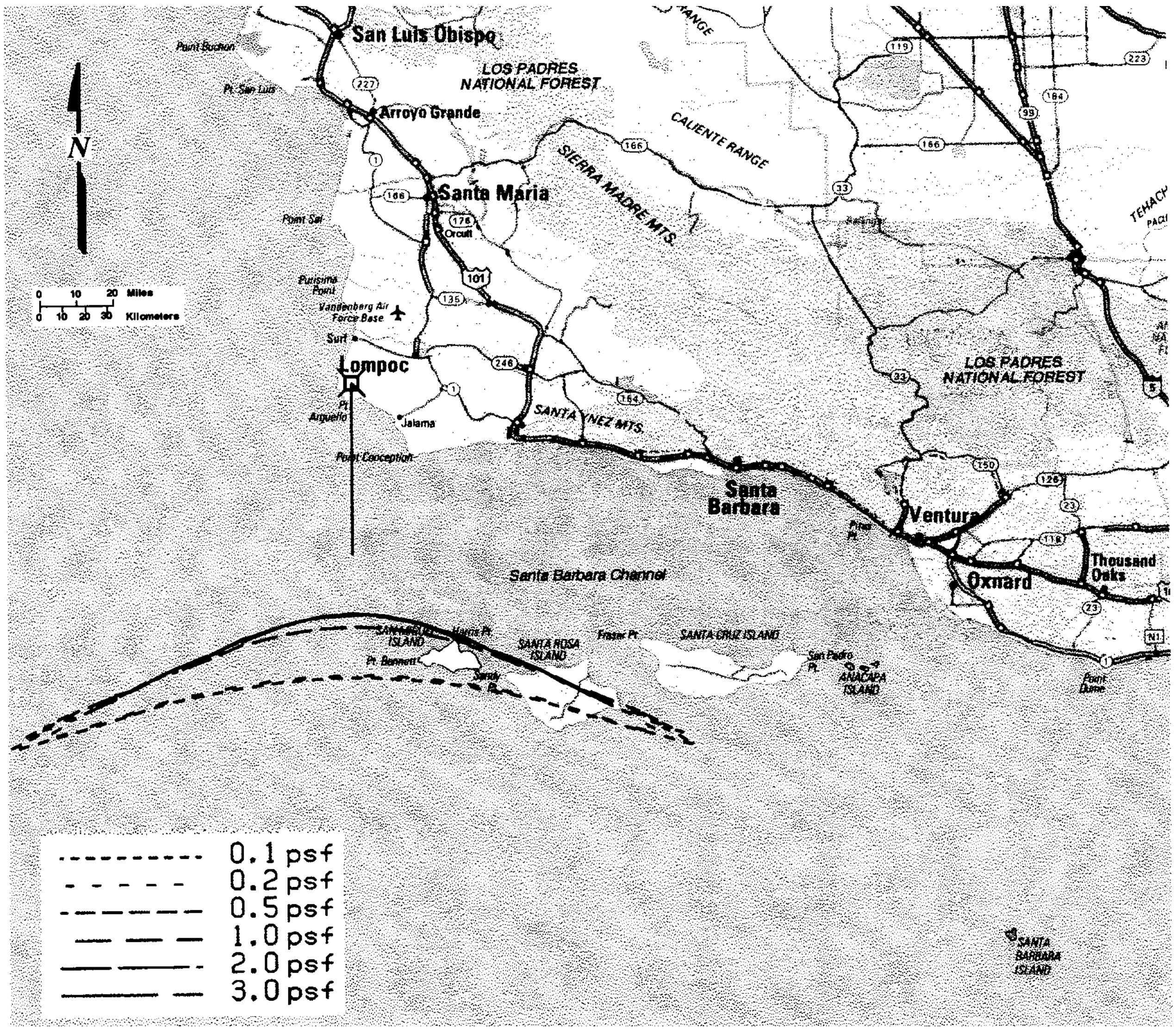



Figure 4.14. Sonic Boom Predicted for the LLV 2 (psf)

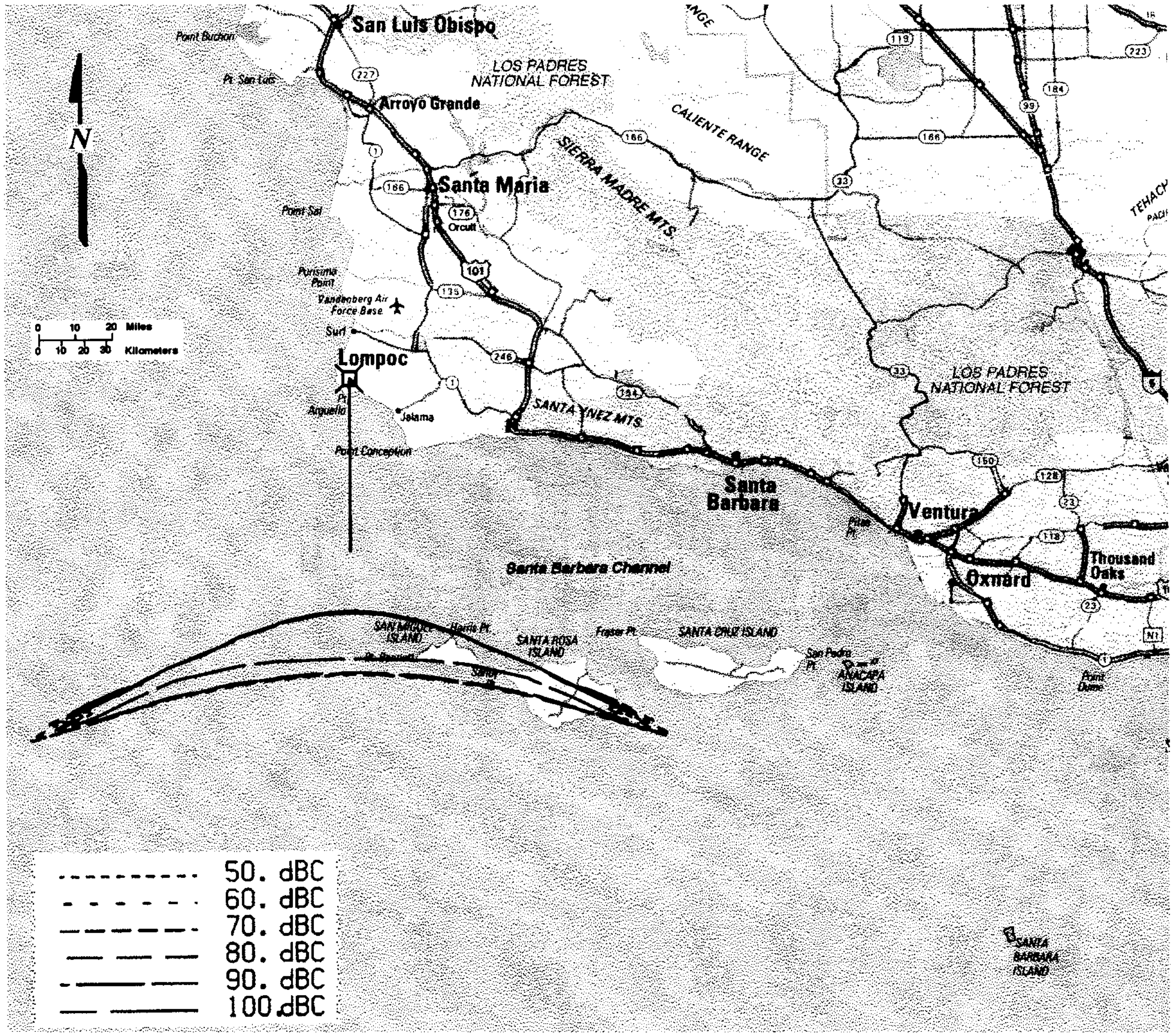



Figure 4.15. Sonic Boom Predicted for the LLV 2 (dBC)

### 4.6.1 Rocket Fuels

Solid rocket fuel would be brought onto Vandenberg AFB sealed within the rocket motors. The rocket motors would not be opened or maintained at the IPF nor at the SLF. Open burning of the fuel is possible with a source of ignition. However, standard safety and handling procedures would ensure that such an incident has an extremely low probability of occurrence.

Hydrazine is used as a propellant for the attitude control system. The hydrazine would be drawn from the Hypergolic Storage Facility (HSF). Transfer and handling of the hydrazine would be conducted by trained operators of the storage and transfer systems.

A cold spill model was used to estimate the hazard corridors in the case of a spill of hydrazine (Table 4-6). This model incorporates conditions of Western Range Regulation 127-1. The results of the model are given in distances to be cleared of personnel in the event of a hydrazine spill. A Tier 1 distance represents an area which is immediately dangerous to life and health. Tier 2 distances are defined where exposures pose some risk to the average individual. The Tier 1 and Tier 2 thresholds for hydrazine are 40 ppm and 2 ppm, respectively.

Table 4-6. Distances for Hydrazine Hazardous Corridor

| Wind Speed (knots) | Size of Spill kg (lbs) | Tier 1 Distance m (ft) | Tier 2 Distance m (ft) |
|---|---|---|---|
| 4 | 227 (500) | 262 (861) | 915 (3003) |
| 25 | 227 (500) | 253 (830) | 883 (2897) |
| 4 | 454 (1000) | 349 (1145) | 1222 (4009) |
| 25 | 454 (1000) | 338 (1109) | 1179 (3868) |

#### 4.6.1.1 Transportation and Handling of Solid Rocket Motors

This section summarizes the transportation scenarios, and potential accidents and risk mitigation procedures associated with the transportation of solid rocket motors to and within Vandenberg AFB. Risks are similar for all of the potential alternative sites, and will be discussed as if only the preferred alternative is being considered. The regulations governing the handling and transportation of solid rocket motors is AFM 91-201 Explosive Safety Standards (7 Oct 94). A supplement to this document governing specific Vandenberg AFB situations has been written, and is in review for final approval (Capt H. Brasher, USAF, personal communication).

Transportation of solid rocket motors such as the Castor 120™ rocket motor and the Castor IV™ strap on booster, the main propulsion systems for the majority of rockets to be launched from the Spaceport, are planned to be by rail via the Southern Pacific Rail line that transits Vandenberg AFB from north to south along the coast. The Spaceport design accommodates the delivery of the motors to the Stack and Checkout Facility (SCF) on the launch complex. This transportation scenario reduces motor handling, and the consequent risk of that handling, to insignificant levels. Rail transportation is generally considered the safest, most reliable method for solid rocket motors. Air Force programs, such as Peacekeeper and Titan IV, have relied upon rail transport for the delivery of large motors and segments of motors. These programs have demonstrated, through accident-free rail transportation, that the risks associated with this method are insignificant. The probability of an accident involving a solid rocket motor is extremely small, but in the remote event that an accident does occur, the effects would be identical to those discussed in section **4.3.2.1 Impacts from Accidental Open Burn of Rocket Fuel**.

The preferred method of transporting solid rocket motors is via rail because of the decreased risk to the public and natural resources afforded by this direct method. Motors would be shipped to Vandenberg AFB on enclosed rail cars from the Thiokol Corporation in Utah. The rail cars will be transferred from the main Southern Pacific line to an existing rail siding located near the South VAFB power plant adjacent to Coast Road (approximately 1 mile north of the preferred alternative). A prime mover would be used to transport the rail car to the appropriate SCF from this siding.

The rail transportation method contrasts with the alternative transportation method of shipping the motors by truck over surface roads; a method some users of the Spaceport may wish to utilize. The motors would be moved down Highway 101, bypassing Santa Maria, south on Highway 101 to State Route 246 east of Lompoc. The motor would proceed on State Route 246, west toward Lompoc. The convoy would proceed to the Coast Gate near Surf for entry to South Vandenberg AFB. From the Coast Gate, the motors would be moved on Coast Road to the Spaceport. The motors would then be transferred from the transportation trailer to the Stack and Checkout Facility.

The risks associated with either of these operations is considered very low, with the rail option clearly being the preferred transportation method.

In the event of an accident near important natural or cultural resources, such as an endangered species, or archaeological resources, Vandenberg AFB staff personnel responsible for the particular resource would be consulted.

#### 4.6.1.2 Transportation and Handling of Liquid Rocket Fuels

This section summarizes the transportation scenarios, and potential accidents and risk mitigation procedures associated with the transportation of liquid rocket fuels to and within Vandenberg AFB. Risks are similar for all of the potential alternative sites, and will be discussed as if only the preferred alternative is being considered.

Liquid fuels would be used to fuel booster attitude control systems, spacecraft propulsion systems, and, perhaps in the future, small liquid upper stages. At present, the major user of hypergolic fuels at Vandenberg is the Titan space launch program. Each launch of a Titan IV rocket consumes 150,000 pounds of Aerozene-50 and 280,000 pounds of $N_2O_4$. If it is assumed that each of the rockets launched from the Spaceport contained 1,000 pounds of hydrazine, it would take 150 launches (or over 6 years, using the maximum 24 per year anticipated launch rate) to consume the same amount of fuel as a single Titan IV. A Titan II consumes 110,000 pounds of Aerozene-50, and 210,000 pounds of oxidizer for a single mission, so 110 vehicles with 1,000 pounds of hydrazine would have to be launched to consume as much fuel. This is not a surprising result, since the Titan family of vehicles is primarily liquid fueled.

Titan payloads also require large amounts of hypergolic fuels. For instance, approximately 8,400 pounds of N2H4 (hydrazine) is required for a single payload.

Liquid fuels, especially hypergolic propellants are very toxic and corrosive, and require special handling to ensure the safety of launch crews and the general public. The propellants, which are delivered from the manufacturers in Mississippi and Arkansas, have been shipped to the base since 1958. The potential risk associated with transporting hypergolic propellants is considered relatively low, estimated at 1.56 accidents per million round-trip vehicle miles traveled between the manufacturing plant and Vandenberg (USAF 1989a). An accident does not necessarily result in a tank rupture. Special construction of the tanker vessels reduces to a minimum the overall chance of a tank rupture. U.S. Department of Transportation (DOT) regulations restrict the type and quantity of hazardous substances to be transported.

In any case, the comparitively minor amounts of required propellants for the Spaceport program would not add significantly to the quantities transported to Vandenberg today. The preferred location for the delivery of hypergolic fuels to Vandenberg is the Pine Canyon Gate. Shipments are safety inspected at the gate before proceeding to the Hypergolic Storage Facility (HSF) on South Vandenberg AFB.

Hydrazine must be moved to the Spaceport for fueling operations for payloads or attitude control systems. This would be done using DOT approved containers, and on approved transportation routes. The approved route between the HSF and the Spaceport (regardless of site selection) is via Mesa Road to Coast Road, south on Coast Road to the Spaceport. Shipments of these hazardous materials would be escorted at low speed between the HSF and the Spaceport. A traffic accident is unlikely at the speeds used to move the commodities.

In the event of an accident near important natural or cultural resources, such as an endangered species, or archaeological resources, Vandenberg AFB staff personnel responsible for the particular resource would be consulted by emergency response teams.

### 4.6.2 Hazardous Waste and Toxic Materials

The implementation of this project would result in the generation of domestic, industrial and hazardous waste. These wastes would be managed in compliance with environmental laws and regulations. In particular, the construction and launch operation contractors would use the Base hazardous waste management system and EPA identification numbers.

Very limited amounts of hazardous or toxic materials are required for service of launch vehicles. Minimal amounts of isopropyl alcohol would be used for cleaning. The small quantities required at the IPF and the SLF would be segregated, labeled, and controlled in accordance with all appropriate regulations. Contaminated wipe material would be disposed of in accordance with the approved procedures of Vandenberg Air Force Base. Individual users would be required to quantify the amounts of hazardous materials to be used and waste to be produced in separate environmental analysis documents. Hazardous materials not used by the user would be removed and disposed of by the users.

A high concentration of chemical energy is released when the main rocket engine ignites. The rocket exhaust would be dangerous for several hundred feet. To ensure that no individuals, vehicles, or loose equipment are damaged or set to flight at the time of a rocket launch, the launch pad would be under continuous observation and security for several hours before each launch. First, the launch complex would receive a safety sweep before launch. Then, a clear zone would be maintained by a security cordon. The safety cordon would be determined during safety planning, approved by Vandenberg AFB, and established and maintained under monitoring and control by Air Force personnel.

### 4.6.3 Flight Safety

The flight of the vehicle would be monitored by Air Force personnel who have authority to destroy the launch vehicle in the event of abnormal operations or a departure from the approved limits of flight from the SLF. The 30 SW Commander has the ultimate responsibility for safety of all space, missile, and aeronautical flights within the Western Range (USAF 1993c).

There are explosive devices required to provide the safe destruction of the launch vehicle in the event the Air Force Missile Flight Control Officer deems it necessary. In the case of the LLV, the main booster engines (Castor 120™) and equipment section booster (Orbus 21D™) have a 300 grain shaped charge attached to each engine. In the event of an LLV 3 launch with the Castor IVA™/IVXL™ strap on rockets, each strap on rocket would have its own perforator destruct charge in the dome of the motor. The destruct charges are Explosive Class 1.3. Each of these destruct charges would be electrically initiated. Final preparations of the launch vehicle would include removing grounding wires and making of the safety circuit just prior to closing the inspection and access ports. Final activation of the safety system would occur only after all nonessential personnel are ordered off of the launch facility. Other launch vehicles would be similarly equipped with destruct systems.

### 4.6.4 Radio Frequency Hazards

This section includes information for the LLV. The other launch vehicles that would use the Spaceport would have similar radio systems for transmissions in accordance with the Inter Range Instrumentation Group (IRIG) standards (USAF 1993c).

There are two 25 watt transmitters on the launch vehicle. One transmitter sends to the ground on the status and activity of the launch vehicle's systems. The second transmitter is a beacon which allows the Air Force range instrumentation to track the launch vehicle during the launch phases.

With proper safeguard against electrical shock, there is no human health and safety hazard from radio frequency radiation by the launch vehicle. The commonly accepted standard (OSHA, ACGIH, ANSI & IEEE) for full body exposure is 10 $mw/(cm)^2$. Assuming a person is 0.5 m (1.5 ft) from an antenna, a conservative calculation estimates 0.4 $mw/cm^2$ exposure (C. Anderson, Personal communication, 1993).

The rocket motor destruct charges are electrically initiated by a combination of high and low voltage systems. In accordance with the safety regulations and procedures of Vandenberg AFB, the use of radio transmitters would be strictly controlled within the safety zone of the SLF. This control would begin before the destruct charges on the launch vehicle are completely connected. The control of radio transmitters would insure that there are no sympathetic currents generated in the destruct circuits as a result of a radio transmission.

### 4.6.5 No-Action Alternative

No health and safety impacts would result from the No-Action alternative.

# 5.0 SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS

The collective activities of the California Spaceport at Vandenberg AFB would constitute only one of an estimated 73 separate programs foreseen in the 30th Space Wing Ten Year Workload Forecast (USAF 1993a). It is also important to remember that the Spaceport would provide facilities and services to existing and future commercial, government, and university space related programs. Except for construction effects, potential environmental impacts due to launches from the Spaceport would not necessarily be additive to effects from other commercial or military users. The Spaceport would be capable of facilitating the majority of commercial and military users in the small and medium weight range planned for launch from Vandenberg in the coming years. The purpose of the Spaceport would be to facilitate existing programs so that they are more competitive in the market. If each of the potential customers of the Spaceport were forced to build, operate, and maintain separate launch facilities for user specific operations, costs and environmental impacts would be prohibitive. By constructing a single, multi-user processing and launch facility, WCSC ensures that US launch providers compete on "level ground" with foreign competitors that are often heavily subsidized by their respective governments. Furthermore, safety and environmental concerns would be much easier to manage at a single, well-maintained site.

Figure 5.1 is a summary of the predicted number of launches per year for the next ten years, along with historical data indicating launch rates from years prior to 1994. Marketing analyses (CCSI 1994) indicate commercial programs will begin to replace military programs that have been canceled or reduced in scope due to changing military priorities. Additionally, commercial launch providers will soon begin competing for launches associated with the expected surge in low earth orbit telecommunications satellite constellations that will take shape in the late 1990's. Several large groups of investors have announced plans for constellations of satellites to service the global cellular telephone market. The ability of commercial firms at Vandenberg AFB to fulfill the launch rates necessary to establish these constellations, and launch replacement satellites when required, would ensure a robust and productive Vandenberg AFB work force.

Launch rates at the Spaceport would increase gradually beginning in 1996, when an initial rate of four launches per year would be attained. A steady increase in launches from the Spaceport would continue to occur until the year 1999 or 2000 when the Spaceport may achieve rates close to the 24 launch per year maximum capacity. Some of these launches may be due to Air Force and NASA programs seeking more economical access to polar orbits than can be provided by Air Force launch programs.

While the total number of Vandenberg AFB launches will potentially increase in the coming years due to commercial programs, the number of large military launch vehicles flown from Vandenberg could decrease. For instance, the Titan program schedule will be reduced from a maximum of five launches per year in 1998, to two or three launches per year thereafter. The Atlas launch program will remain steady through the same period at two per year. As shown in Figure 2.12 (page 33), commercial programs will launch small- to medium-sized vehicles with much less potential for environmental impacts than larger military rockets.

## 5.1 Previous Environmental Impact Analyses at South VAFB

Spaceport launch activities would center around the IPF and the SLF. Both of these facilities would be located at SLC-6 on South Vandenberg AFB. The IPF is currently a component of SLC-6, which was originally intended to serve as the launch site for the Manned Orbiting Laboratory (MOL) program in the 1970s. The MOL was to be lifted by a Titan IIIM rocket. The MOL program was canceled in the late 1960’s before the first launch from SLC-6.

Figure 5.1. Vandenberg AFB Workload (launches per year)

SLC-6 was modified by a large construction project in the early 1980s for military applications, which would have used the Space Shuttle to deliver payloads to orbit. An environmental impact statement and a supplement to the statement were prepared for the Space Shuttle program (USAF 1978, 1983). Numerous potential impacts were identified and evaluated. None of these impacts were so severe as to limit the intended space flight program. However, as a result of unrelated developments and changing military requirements, the Space Shuttle program from Vandenberg AFB was canceled in the late 1980s before the first flight.

SLC-6 was considered as a candidate launch site for the Titan IV/Centaur program after the Space Shuttle program was canceled. An environmental impact statement was prepared for a Titan IV/Centaur program with two options: (1) to build a new launch complex at Cypress Ridge, or (2) to modify SLC-6 for Titan IV/Centaur launches (USAF 1989a). The SLC-6 option was chosen for the Titan IV/Centaur project. However, again due to unrelated developments and changing military requirements, the program to launch the Titan IV/Centaur from Vandenberg was canceled in the early 1990's.

### 5.2 Conclusions of the Environmental Impact Analyses

There are a variety of potential environmental impacts which are plausible for rocket launching programs such as that proposed by WCSC. Some of these would be highly unlikely to occur. A comprehensive set of Monitoring and Mitigation Requirements (see Appendix G) have been developed to offset any potential impacts to non-significance. The environmental consequences of the proposed Spaceport program at each of three potentially viable alternative sites have been contrasted and compared. Figure 5.2 is a summary chart designed to show the relative environmental impacts of the two viable alternative sites in relationship to impacts at the preferred alternative. The chart is qualitative and shows only lesser or greater impacts, but not how much greater or lesser. For instance, because there are fewer cultural resources to contend with at the preferred alternative site than there are at the other two sites, cultural resources are judged to be greater impacts at SLC-5 North and Cypress Ridge. On the other hand, the preferred alternative is closer than either of the other two sites to the peregrine falcon nesting area so peregrine falcons are judged to be impacted to a lesser degree at either SLC-5 North or Cypress Ridge.

| Resource | SLC-5 North | Cypress Ridge |
|---|---|---|
| Cultural | ↑ | ↑ |
| Visual | ↔ | ↑ |
| Jalama Beach | ↑ | ↔ |
| Wetlands | ↑ | ↓ |
| Pinnipeds | ↓ | ↑ |
| Peregrine Falcon | ↓ | ↓ |
| T&E Wildlife | ↑ | ↓ |
| Candidate Animals | ↔ | ↔ |
| Candidate Plants | ↑ | ↑ |

↑ Increased Impacts
↔ No Change
↓ Decreased Impacts

Figure 5.2. Summary of Spaceport Environmental Consequences in Comparison with the Preferred Alternative Site

The US Fish and Wildlife Service preferred the Cypress Ridge alternative. While realizing that the selection of the Spaceport location could not be based solely upon biological considerations, they believe that Cypress Ridge presents: (1) fewer potential impacts on Honda Creek, (2) a reduction of overall noise impacts, (3) the avoidance of higher quality habitat, and (4) less pinniped impacts.

### 5.2.1 Cultural Resources

#### 5.2.1.1 Preferred Alternative, SLC-6 South

The SLC-6 complex has been evaluated and recommended not eligible for inclusion on the National Register (Corbitt 1994). The SLC-6 evaluation report has been submitted for SHPO consultation with a request for concurrence with this recommendation.

Archival and background research indicates that a complete pedestrian survey of the preferred alternative's APE was conducted, and no prehistoric sites are recorded within the project APE. No impacts to prehistoric resources are expected. However, because of the buried nature of nearby cultural resources, monitoring of construction activities would be conducted if this alternative is selected.

Background research indicates that the preferred alternative's APE is located beyond the viewshed of the Anza Trail. No impacts to this resource are expected from the proposed project.

#### 5.2.1.2 Cypress Ridge Alternative

Based on an extensive literature search, a surface survey, and subsurface testing at the Cypress Ridge alternative, no impact to eligible prehistoric resources is expected from the proposed project. However, because of the buried nature of nearby cultural resources, monitoring of construction activities would be conducted if the Cypress Ridge alternative is selected.

The ethnohistoric study conducted for the proposed project indicates that under the guidelines specified in 36 CFR 60 and supporting documents, the "Western Gate" is ineligible for inclusion on the National Register (Wilcoxon 1994). Because of continuing use by Native Americans and other groups of areas south of Cypress Ridge, however, it is recommended that, if this alternative is selected, a system be created by which key individuals are kept informed of anticipated launches, so that they can plan their activities accordingly.

This alternative is within the Anza Trail viewshed (Bradley 1994). If this alternative is selected, additional Section 106 compliance would be conducted to evaluate the trail and identify potential mitigation measures.

#### 5.2.1.3 SLC-5 North Alternative

Five prehistoric and historic sites are recorded within and near the SLC-5 APE. Of these, two are considered potentially eligible for inclusion on the National Register and would be avoided.

This alternative is also within the Anza Trail viewshed (Bradley 1994). If this alternative is selected, additional Section 106 compliance would be conducted to evaluate the trail and identify potential mitigation measures.

### 5.2.2 Land Use and Demography

Launches at the SLF would have a negligible impact on land use, relative to other rocket launching programs previously considered at SLC-6 and at the proposed SLC-7, or other active and currently operating programs such as the Titan program at SLC-4 and the Atlas program at SLC-3. In general, less than 100 people would be stationed at the Spaceport at any given time. The total workforce, from all direct and indirect sources, associated with the operation and maintenance of the Spaceport would be approximately 400 personnel. This would not create an undue burden on the social infrastructures of the nearby communities.

The environmental impacts from all launch vehicle programs that would potentially be supported by the Spaceport would be similar and encompassed by the analysis of the LLV family of vehicles (see Figure 2.12). As previously discussed, the noise and exhaust plumes associated with launches of this family of rockets would be representative of a “worst case” scenario. Analyses presented within this document were conducted assuming all launches would be the LLV 3(6), the largest vehicle that would be serviced at the Spaceport. Land use impacts of this “worst case” launch program were found to be less than those for other active space launch programs on Vandenberg AFB, as well as the proposed Titan IV/Centaur or the Space Shuttle (USAF 1983, Environmental Solutions 1990a). 30th Space Wing flight safety procedures would ensure no impacts to communities and populated areas of western Santa Barbara County.

The visual resources to the southeast of Vandenberg AFB would not be affected by locating the SLF at the SLC-5 North or the preferred alternative sites. The view of these areas from Jalama Beach County Park is blocked by Cypress Ridge. However, the Cypress Ridge alternative location is in the viewshed of Jalama Beach.

Launches of rockets from the Spaceport, regardless of which site is selected, would be in accordance with the required Air Force ground, range, and flight safety regulations. Beaches and other recreation areas on Vandenberg AFB near the launch site, such as the Boathouse area, would be periodically closed to ensure public safety during launch operations. However, the duration of any closures would be as short as possible, while still maintaining the public's safety. Because of the low explosive content of the launch vehicles and the location of the preferred alternative well to the south of populated areas of Vandenberg AFB, the area of closure would be limited to sections of SVAFB, and would not include as many recreational resources as for the Titan/Centaur at the proposed SLC-7, the Space Shuttle program at SLC-6, the Titan program at SLC-4, or the Atlas program at SLC-3.

If either the preferred alternative or the Cypress Ridge alternative are chosen, there would be no closure of the Jalama Beach area for launches. Because of the greater width of the potential debris impact area for similar launches from SLC-5 North, there would be greater potential for closure of Jalama Beach if this alternative were selected.

### 5.2.3 Atmospheric Resources

The total work force would normally be fewer than 100 people, therefore vehicular traffic and associated automobile pollution would not significantly increase from the current levels at Vandenberg AFB.

Potential impacts due to construction effects, such as fugitive dust and construction vehicle emissions, have been quantified and analyzed in the Clean Air Act Conformity Analysis (see Appendix E). Potential construction impacts would be minimized through design constraints and watering to inhibit dust production.

The Castor 120™ is representative of solid rocket fuels which would be used at the Spaceport. The first stage booster would produce exhaust products that are expected to dissipate before reaching sensitive human, flora or fauna receptors. The total potential atmospheric acid deposition from a Lockheed Launch Vehicle (LLV-3(6)) would be less than 1/4 of the deposition rate from a Titan IV, which currently launches from SLC-4. The total HCl deposition from 24 LLV 3(6) launches would be approximately 138 tons below the 3,000 foot mixing altitude. In contrast, a single Titan IV launched from SLC-4 would deposit approximately 35 tons below this altitude. Titan launches also use 26,000 gallons of water as a sound suppression system. The addition of this water causes the formation of hydrochloric acid droplets that are deposited upon local biota. No significant effects from acid deposition have been noted at SLC-4. The Spaceport launch duct would not include a water sound suppression system. Moreover, the Titan IV HCl deposition rate was noted as not a significant impact in the EIS for the Titan IV/Centaur program (USAF 1990). The solid booster would also produce an insignificant amount of acid rain when compared to the Space Shuttle in Florida. Furthermore, monitoring of Space Shuttle exhaust emissions at Kennedy Space Center in Florida resulted in "no indication of any adverse impacts from Shuttle launches to rain chemistry" (Madsen et al. 1986:ii). When atmospheric HCl deposition rates from rocket launches are compared with local natural sources of atmospheric HCl, such as the ocean, the deposition rate for Spaceport launches is insignificant. Solid fuels used in rocket motors, such as the Castor 120$^{TM}$, are considered to be generally safe to the atmosphere. Extensive analyses have been performed and concluded that "the effects of rocket propulsion on stratospheric ozone depletion, acid rain, toxicity, air quality, and global warming were extremely small compared to other anthropogenic impacts (AIAA Workshop 1991:1).

**5.2.4 Soil Resources**

There would be no construction at the IPF. Therefore, there would be no new or exacerbated soil erosion conditions.

Impacts to soil resources would be primarily due to construction activities. Construction of the SLF would disturb approximately 4.6 ha (11.4 ac) of soil and underlying substrate. Appropriate erosion control measures would be implemented during construction. After construction of the SLF is complete the soils would be stabilized. There would be no further disturbance to soils from operation of the completed SLF.

Acid deposition from the rocket exhaust plume would be minimal due to high vehicle acceleration rates and the use of a “dry” launch duct. In addition, HCl from rocket exhaust would have no effect on the local soils due to their highly buffered characteristics. Finally, aluminum oxide would not affect the soils because it would be deposited as a stable compound.

**5.2.5 Water Resources**

There would be no impacts to either surface water quality or ground water quality as a result of commencement of activities related to rocket launching at the IPF. Restoration and use of selected utilities would improve the probability that the environmental systems for drinking water and wastewater treatment would operate as designed. There would be no major withdrawals of groundwater or use of surface water.

There are no jurisdictional wetlands in the immediate vicinity of the IPF or the SLF. The nearest bodies of surface water are normally beyond the range of expected impacts from the Spaceport due to prevailing winds from the NW to the SE. Moreover, the high acid neutralization characteristics of the local drainages, such as Honda Creek, would counteract any acidic deposition from the Spaceport rocket launches. Winds may be from the south approximately ten percent of the year. When this occurs, water quality monitoring of Honda Creek would be conducted as described in the Monitoring and Mitigation Requirements (Appendix G). If impacts were to occur due to Spaceport launches, launch schedules would be adjusted to avoid unfavorable wind conditions.

**5.2.6 Biological Resources**

**5.2.6.1 Vegetation**

Construction impacts to coastal sage scrub vegetation would be mitigated on a 3:1 basis. In order to provide a more complete understanding of the effects of the launch rates anticipated at the Spaceport, near field vegetation would be monitored for potential launch related impacts per the Monitoring and Mitigation Requirements in Appendix G. Monitoring for plant species of special interest would not be conducted unless either the Cypress Ridge or SLC-5 North alternative site is selected. Fires, explosions, and fuel spills constitute potential biota impacting events, but these are highly improbable. Vandenberg AFB emergency reaction procedures already exist to minimize impacts from this type of event.

#### 5.2.6.2 Wetlands

No jurisdictional wetlands are located within the footprint of the preferred alternative site. The overall project site location of the preferred alternative is concluded to be a non-wetland as defined by the Army Corps of Engineers Delineation Manual. Therefore, Section 404, Clean Water Act permitting would not be required.

Under the preferred alternative and the Cypress Ridge alternatives, the Spaceport would not be located in the near vicinity of any major drainages. The nearest major drainage is Cañada Honda Creek, which is 2.4 km (1.5 mi) to the north of SLC-6. Since the exhaust plume and launch noise would be directed toward the south of the launch site, they would not affect Cañada Honda Creek or any other wetland unless winds were from the south. The potential for winds from the south occurs approximately ten percent of the time during the year. If there is a potential for winds to be from the south on launch day, Honda Creek monitoring procedures, per Appendix G, Monitoring and Mitigation Requirements, would be implemented. If significant impacts were to be noted due to launches from the Spaceport, launches would be rescheduled to avoid unfavorable weather conditions. On the other hand, because of the close proximity of SLC-5 to Cañada Honda Creek, there would be greater potential for significant impacts to occur if the SLC-5 North alternative were selected.

It is concluded that launches from the preferred alternative would likely not impact Cañada Honda Creek. Monitoring of water quality and vegetation inspections would be conducted to verify this conclusion.

#### 5.2.6.3 Wildlife

Several wildlife species of concern are within the region of influence of each alternative site and would be monitored for launch effects. If a significant impact such as reduced population levels or reduced habitat usage is shown to be caused by rocket launches from the Spaceport, mitigation would be implemented in consultation with the VAFB and USFWS as stated in Appendix G.

#### 5.2.6.4 Threatened and Endangered Species

Fish species and amphibians in Honda Creek are not expected to be affected by launches from the Spaceport. Water quality data would be collected before and after launches when winds are predicted to blow from the south on launch day. If detrimental water quality changes occur, and the changes are related to Spaceport launches, then launches would be rescheduled to avoid these wind patterns.

California least terns are outside the region of influence for all alternative sites. Western snowy plovers are outside the region of influence for all alternative sites except SLC-5 North. Security patrols would utilize only trained personnel to clear VAFB beaches in preparation for launch if this alternative is chosen. California brown pelicans are not likely to be affected by Spaceport launches but are known to roost within the Spaceport ROI and could be flushed by low flying security helicopter security patrols. This species would be monitored.

Peregrine falcons would experience loud noises during launches from the SLF when they are present in the region of influence. Sound intensities would be approximately 100 dBA. The available information indicates that these species would likely not suffer mortality or reduced reproduction from launch noises associated with the SLF. However, if the preferred alternative is chosen, a hacking program would be instituted to offset any potential impacts to this species, in accordance with the Monitoring and Mitigation Requirements in Appendix G. Hacking is the controlled release of young birds ata site with the objective that they would survive and return to breed. For this project, the released birds would be captive bred.

#### 5.2.6.5 Marine Mammals

Pinnipeds and southern sea otters would be within the region of influence for the Spaceport for all three alternative sites. Pinnipeds are known to startle in the presence of loud noises such as those produced by rocket launches.

With respect to pinnipeds, the SLC-5 North location would have the least potential for significant impacts and the Cypress Ridge alternative would have the most potential. The preferred alternative would be intermediate in its potential. Although this potential is considered to be low, this would be evaluated by monitoring of pinnipeds and southern sea otters. Alternatively, mitigation would be implemented before the first launch from the Spaceport.

**5.2.6.6 Channel Islands**

Harbor seals and other pinnipeds on the Channel Islands may be subjected to a minor sonic boom from Spaceport launches. However, previous monitoring for a recent Titan IV launch in August 1993 did not document any significant impacts to these species from sonic booms.

The maximum focus boom from the LLV 1 and the LLV 2 would be 62 dBA and 79.5 dBA, respectively. The focus boom from the LLV 3 would miss the Channel Islands completely. These are well below the previously identified threshold of 101.8 dBA for Titan IV launches.

It is concluded that launches from the SLF would not produce a significant impact to pinnipeds on the Channel Islands from sonic booms. Sonic booms would not be monitored nor would mitigation be implemented.

**5.2.7 Health and Safety**

The solid rocket fuels are the safest fuels available (AIAA Workshop 1991). Moreover, the components of these rockets are of high levels of reliability. Finally, all activities associated with the Spaceport would be conducted in accordance with applicable Air Force regulations and procedures. Therefore, the safety associated with launches from the SLF would be well within acceptable limits.

Analyses of potential catastrophic conditions indicate that levels of danger do exist from hydrazine, the use of hazardous and toxic materials, and during the early stages of launches from the SLF. As a result of these analyses, appropriate protection measures have been designed and would be implemented throughout the duration of the Spaceport program.

**5.3 Cumulative Effects on South Vandenberg AFB**

Proposed launch rates at the Spaceport would be 24 launches per year. While greater launch rates have been experienced at Vandenberg AFB, information concerning the environmental consequences of such rates is incomplete. Comprehensive Monitoring and Mitigation Requirements (see Appendix G) have been developed to offset any potential impacts. For instance, a peregrine falcon hacking program would be instituted to detect and mitigate and to offset the potential for significant impacts. The mitigation and monitoring program would include establishment of baseline conditions for certain resources. Other mitigations and monitoring would be conducted to identify and offset remaining impacts, if required, in accordance with the Monitoring and Mitigation Requirements in Appendix G.

Figure 5.1 represents the total predicted work load for Vandenberg AFB in the coming years. The Spaceport would provide the capability to launch the majority of commercial and military satellites within the weight range of 500 lbs. to 8,000 lbs. Figure 5.1 assumes that all launches in this range would be from the Spaceport. This may or may not happen because the Air Force would still make excess facilities available to government and commercial users on a case-by-case basis. The Spaceport must be the most cost-efficient and convenient place from which to launch before customers would be convinced to perform operations there. Therefore, some of the predicted launches on the figure may be launched from other locations on Vandenberg. The total number of launches would remain the same while the relative numbers that launch from the Spaceport and other launch facilities would change. However, for commercial launches to be competitive, they must be launched from South Vandenberg AFB. This is because launches from North Vandenberg AFB require a “dogleg” maneuver to prevent the overflight of populated areas. The Spaceport would prevent the wasteful and inefficient duplication of space launch facilities by individual launch services companies.

The Spaceport program would be only one of several contributors to human activities on South Vandenberg AFB and therefore would not add a major increment to water consumption, air pollution from vehicles, or special hazards. The majority of the rocket fuels used for Spaceport rocket launches are the safest fuels available and can be safely handled with simple precautions (AIAA Workshop 1991). The Spaceport program would generate comparatively very small amounts of hazardous waste.

The Spaceport would not be expected to have a cumulative impact on air quality. First, there are relatively low levels of HCl and $Al_2O_3$ emitted per launch. These would quickly dissipate into the atmosphere. Second, rocket launches from the Spaceport would be an intermittent activity. The minor and transient nature of the impacts are not additive from launch to launch. There would be sufficient time between each launch for the rocket exhaust to dissipate according to the normal dispersion qualities of the atmosphere. Therefore, there would be no cumulative impacts on local or regional air quality.

The long-term, cumulative effects to the local and regional biota would also be expected to be insignificant. This is indicated by the low levels of rocket exhaust which would be emitted per launch, the natural dissipative properties of the atmosphere, and the high buffering capacity of the soils. Moreover, information available for sensitive species, such as the peregrine falcon and the harbor seal, indicates that they can withstand repeated human disturbance and noise without negative effects.

This conclusion is also supported by analyses of 43 launches of the Space Shuttle in Florida, which concluded that there were no cumulative effects to the biological resources near the launch area (Schmalzer et al. 1993). In a separate study, no mortality or long-term effects to scrub jays were identified during a 2.5 year study of Titan IV launches at Cape Canaveral (Larson et al. 1993). Since the Space Shuttle and the Titan IV are much larger than any of the rocket systems proposed for the Spaceport, it is expected that the cumulative impacts to the flora and fauna, and to the biological environment, from the Spaceport would also be insignificant. Comprehensive and on-going monitoring of the biological resources surrounding the chosen Spaceport site would be conducted to evaluate the long-term and cumulative impacts of the launch rate proposed for the Spaceport.

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